APR 2 1889
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THE TELEGRAPHIC JOURNAL AND
ELECTRICAL REVIEW.

VOL. XXIV. MARCH 22, 1889. No. 591.

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THE COPPER MARKET.

THE blow, so long expected, has at last fallen, and the disaster consequent upon the collapse of the copper syndicate is unfortunately not confined to the Société des Metaux. Many Paris banks are involved, to a greater or less extent, in the speculation, the Comptoir d'Escompte de Paris being, perhaps, the largest sufferer. Copper quoted at £80 per ton but a short time ago is now nearer £40, and it is not at all unlikely, considering that the stock in hand amounts to about 150,000 tons, that the price will fall to £35 or £37.

Had the speculators been content with a moderate profit, there seems no reason why they should not have been able to unload at a remunerative rate, but the attempt to keep up a price of £75 to £80 for an article whose commercial value is about £40, was a very risky experiment.

The evil influence of the crash will no doubt make itself further felt by retarding electric lighting in Paris. The six sections into which the Municipality had divided the area to be illuminated, were each to be lighted by a separate company. These companies depended, to a large extent, upon the banks for the supply of funds. So large an undertaking as the electric lighting scheme must necessarily require a very considerable outlay, and the banks, nearly all more or less implicated in the copper speculation, will be shy, at all events for the present, of embarking in any very extensive enterprise.

There are still other evils traceable to the actions of the copper syndicate. Many mines have been reopened, or have sprung into existence owing to the abnormal inflations in the price of copper. These mines, with the metal at a normal price, could not be worked, and the money spent in giving them a temporary life will be lost.

What with the failure of the Panama Canal scheme and the losses consequent upon the collapse of the copper speculation, the year 1889 has had in France an unfortunate commencement.

USEFUL ELECTRICAL QUESTIONS FOR TROPICAL CLIMATES.

UNDER this heading, our contemporary the *Electrical Engineer*, of March 15th, asks the following questions:—

1. Is the coefficient of variation of resistance with temperature mathematically correct for copper coils, and more especially for galvanometer coils?

2. Is capacity variable with temperature?

3. Are high resistance coils of platinum-silver reliable, or is it not a fact that, under certain climatic conditions, they show residual charge—that is, act to a certain extent as a secondary cell, destroying the accuracy of tests?

With regard to the first question, it is generally accepted that the coefficient for variation of resistance with temperature is correctly assumed to be, for copper 0·209, for German silver 0·024, for silver platinum 0·017, and for platinum iridium 0·034 per cent. per degree Fahr.

We believe, in reply to the second question, that it is generally admitted that the effects of temperature on capacity are, so far as practical work goes, absolutely *nil*.

In answer to the third interrogation, we consider that provided the silk covering of the wire is *well* dried at a high temperature and the coils are *afterwards* saturated with hot pure paraffin wax, so that moisture is excluded and not bottled up, there will be no error through polarisation. Where climatic conditions affect in a great measure the resistance of coils, is, of course, with regard to the marked value of the coils. These are adjusted at a certain temperature, and when used in a much higher or lower temperature than that at which they were adjusted, would manifestly indicate erroneous resistances, and consequently necessitate correction. A difference of 30° Fahr. either above or below the temperature at which the coils were adjusted, would be equivalent to an error of 0·84 per cent. in the reading, or to an absolute error of 4° Fahr. in the apparent temperature of the core of a cable as calculated from the conductor resistance when the latter is measured by the coils in question.

WE have had further opportunities of examining the working of the series traction system of running cars by electricity at Northfleet, and on this occasion the tests were more severe than those to which the plant was subjected on the occasion of the visit of the technical press representatives. The day was exceptionally fine and, as on Wednesday of last week, the conditions were eminently favourable for successful demonstrations. The tests were made in the presence of some 50 or more gentlemen personally interested in town and country tramway lines, and amongst them were several connected with Parisian companies. The running appeared to please everybody, and the principal fact which the tramway men seemed desirous of ascertaining was the distance within which the cars could pull up at a dead stop from the instant of a certain signal. Several examples of this kind were given when running at speeds varying from seven to ten miles per hour, and the results generally appeared to give satisfaction. The merits of the system appeared to us to show to far greater advantage than at our first inspection, because the working conditions were made more severe. There are several points, however, upon which we desire to offer a few remarks, not in the way of adverse criticism but for the purpose of ascertaining whether they have been considered by the Company's engineers.

THE sudden stoppages when running at a good speed were performed not with an ordinary brake but by momentarily short circuiting the motor and immediately reversing the current through the field magnets. As the motor is boxed in we had no opportunity of observing what took place at the commutator, but it appears probable that considerable sparking would take place. If this method of pulling up were much employed, how long would the commutator stand against such treatment? It is very likely that Mr. Manville can set our doubts at rest upon this point and such we hope will be the case.

ANOTHER matter in connection with the construction of the conduit seems to us deserving of attention. The method appears to be similar to that adopted in some cable tram lines laid down, we believe, in San Francisco. Engaged upon some of these after a hot day might have been seen hundreds of workmen spiking open the slotted rails whose grooves had become narrowed by the expansion of the metal frames in the conduit. Is it likely that such a result will happen to the Northfleet line in the height of summer, or has this contingency been foreseen?

WE were told that but little fear is to be apprehended of leakage in the conduits, but on this point we think the engineers of the Syndicate will find themselves mistaken, notwithstanding the fact that the earth is not used as a return circuit. Holroyd Smith was very unfortunate in this respect at Blackpool at the beginning of his labours, and, although the two plans are dissimilar, we think that surface leakage will become a factor with which the Northfleet experimenters must contend. Up to now the weather has been altogether in favour of the trials and we are much concerned to learn the results of working under the very worst circumstances. This, however, we may have to wait for until another winter has set in. One circumstance in connection with these experiments should not be overlooked, for whereas in all the other systems which have been tried and found wanting in this country full sized cars have been employed, those in use at Northfleet only seat 20 passengers, 10 on each side.

AFTER Government inspection, which is expected to take place this week, we understand that the two cars of the series Syndicate will commence regularly plying for passenger traffic. This is to be carried on for some little time, when it is believed that figures sufficiently accurate for all practical purposes will be available to ascertain the actual cost of electrical traction with underground conductors and cars running in series. There is no room for doubting that the price will be materially less than is now paid for the cheapest horsed tramway, and probably nearly identical with estimated cost, and we believe we are correct in saying that the Syndicate would not be averse to taking over the working of tram lines generally at the rate of 4½d., or even less, per car mile. Whilst upon this point it is not unadvisable to ask when shall we adopt a more definite term than the unmeaning "car mile"? It must be changed, and the sooner the better. Finally we feel sure that everybody interested in the development of electric traction, including the promoters of rival schemes, are heartily desirous of the practical and commercial success of the Series Electrical Traction Syndicate, and in this good wish we yield to none.

THE Taunton Electric Light Company is not satisfied with having made Taunton famous for its successful electric street lighting, but is desirous of seeing the town acquire also a reputation for love of the æsthetic, or, at any rate, of the beautiful. In a letter which the secretary has just written to the Town Council, the company reminds the Council that a number of deputations is expected to visit Taunton during the present year to inspect the electric lighting arrangements, and that therefore the present is a good time to replace the existing lamp-posts by new standards of a more ornamental character. The old posts were erected for the sake of cheapness at a time when the success of the electric light was considered doubtful, and the electric light company thinks the time has now arrived when, pecuniary success having been attained, some regard should be had to the adornment of the streets.

PROF. GEORGE FORBES'S remarks respecting the longevity of lead covered cables were evidently the result of insufficient consideration. Even supposing that the cables were in iron pipes and galvanic action was set up between the iron and lead, the iron should go and not the lead. Indeed the action should be a protective one so far as the latter metal is concerned. We should like to hear what Prof. Forbes has to say regarding this matter.

WE are informed that the North Woolwich firm, W. T. Henley and Co., is to be reconstituted. We are not aware of the circumstances which have led to this reconstruction, but we feel that there is a good future before the company, and that its present position does not do its former *prestige* justice.

OUR readers will remember the challenge issued by Mr. Harold P. Brown to Mr. George Westinghouse for an "electric duel," the challenger proposing that he should subject himself to the continuous current while his opponent should submit to the alternating current, the combatant first retiring, or first killed, to be regarded as having his theory and opinion as to the relative safety of the two methods defeated. A comic French paper has been inspired by this incident to put before the world its idea as to the manner in which an electric duel should be fought. First we have the salute. In the foreground are discovered the duellists, foils erect, in the acceptedly correct posture (or a caricature of it). On the one side, and midway between the combatants, is an apparatus bearing a strong resemblance to the machine of the baked potato man of happy memory, but this is evidently intended to represent an electrical arrangement of some kind, perhaps an engine and dynamo combined, for wires extend on both sides to the feet of the duellists. The baked potato man, or the engineer, or whatever he may be, is busy firing up, whilst the seconds, four in number, occupy the back of a seat opposite, where they are huddled together in seeming trepidation as to the result of this unearthly fight. In the background is that essential feature of a landscape in the district round Paris—the Eiffel Tower. The next illustration shows both combatants at the lunge; they are well out of reach of each other's foils, by the way, but the sudden propinquity of the knobs of the foils leads to the completion of the circuit and a bright flash as the discharge takes place, to the amazement of the seconds, who prepare for flight. The baked potato engineer calmly surveys the proceeding unmoved, arms akimbo and pipe in mouth. The final scene witnesses the disappearance of the principals in incandescent gas (where procured or how produced is not shown), and the utter rout of the horror-stricken seconds. The baked potato man alone remains undismayed; he removes the pipe from his mouth, it is true, but that is merely because the show is over, the spectators are gone, and there's no more business to be done, so he may as well pack up and be off.

THE central subway scheme is progressing favourably. One possible opponent has just been satisfactorily dealt with, as clauses have been settled with the United Telephone Company which might have anticipated interference with its lines. It is usual when a new undertaking is contemplated for a cloud of formal objections to be lodged, merely for the purpose of giving the objectors a *locus standi*, in the event of any interference with their rights and privileges arising. That course has been adopted in this instance, and we are glad to find that there will be one objector the less.

THE progress which electrical tramlines are making in America is almost incredible. In the last issue to hand of the New York *Electrical World* no less than six new lines were described. Here, if we can publish anything relative to electric traction once in three months, it produces an impression upon the reader's mind that things are moving.

THE article condensed from Major Raymond's report on underground wires, which we publish in another column, will be found of considerable interest, and our readers will have no difficulty in crediting a lengthy letter which there appears, to the rightful author. When the question of putting conductors underground really become a serious matter in London and other large towns in England, the back numbers of the REVIEW will be found to be replete with information on American practice.

WE shall probably have a good deal to say upon the long letter with which Judge Weatherbe has favoured us in our next issue, when we shall also be able to deal with a communication from Captain Trott, which, however, arrived too late for insertion to-day. The Judge evidently thinks, fallaciously however, that like the "longshoremen" "we aint no sailors bold, and we've never been out to sea," and we cannot, without protest, allow our correspondent to put forward such a statement that no other skilled knowledge is necessary in arriving at a conclusion upon a subject so important as the one under consideration, than that which properly enables one to weigh testimony. The Judge may be infallible in sifting evidence; but if he is, he can come to no other conclusion than to support our views, as the *weight of evidence* is certainly on our side. Even the quotation from our esteemed contemporary the *Electrician*, respecting the speed of working through cables, does not convince us that the Judge has made out a clear case for himself. He forgets that the sea water is in direct contact with the served core of the cable, therefore we do not see how the iron sheathing can exercise any retarding influence upon the working speed.

THE "tender specimen," which appears on page 328, has been forwarded to us from abroad by a gentleman whose name is not unknown in electrical circles. He guarantees the fairness of the translation, which will amuse, if it does not give rise to more serious feelings.

OUR correspondence columns show that the minds of inventors were busy nearly 30 years ago with the problem which Messrs. Siemens Brothers claim to have so recently solved. As has frequently been remarked in our pages, this particular improvement appears to be more imaginary than real.

MR. HOLROYD SMITH seems to have recently developed a *penchant* for threatening other workers in the same line with lawsuits for infringements of his patents. Not contented with commencing an action against a well-known engineer who, we understand, had tried and abandoned many of Mr. Smith's pet schemes before that gentleman entered the arena of electric traction, he states in the last number of *Industries* that Messrs. Elwell-Parker are using for the motors of the Birmingham Tramway Company the self-same brushes which he specially designed for the Blackpool cars. He wishes it to be specially understood that he, and he alone, holds the patent for the same. Is Mr. Smith trying to establish another monopoly?

WE would inform the *Journal of Gas Lighting* that it is in error in asserting that Mr. Preece still thinks incandescent lighting preferable to arc lighting for street illumination. There was a time, certainly, when he held that opinion, but that was years ago; his own experiments at Wimbledon, and the improvements in arc lamps since that date, have been sufficient reason for a right-about-face. Mr. Preece advocated to the Commissioners of Sewers the employment of arc lamps for the main streets, supplemented by incandescent lamps in those smaller and less busy.

ELECTRICAL EXHIBITS AND THE INSTITUTE OF JOURNALISTS.

[A COMMUNICATION.]

AT a *conversazione* at the Mansion House on Saturday evening, March 9th, when the Lord Mayor and Lady Mayoress received and entertained the members of the Institute of Journalists, a varied and instructive exhibition of electrical inventions formed one of the principal features of attraction. For newspaper men Edison's phonographs, several of which were lent by Colonel Gouraud, have a special interest, and the demonstrations were listened to by crowds of the guests throughout the evening. There were four of these instruments in operation—one for making records, one for reproducing them, and two for low records. The several programmes carried out were these:—

Speech Records.—Mr. Edison's first phonogram to Colonel Gouraud (being the first voyage of a voice). Colonel Gouraud's first phonogram to Mr. Edison. New Year's greetings from the Mayor of New York to the Lord Mayor of London. New Year's greetings from the Lord Mayor of London to the Mayor of New York. The Right Hon. W. E. Gladstone's phonogram to Mr. Edison. H.R.H. the Prince of Wales's phonogram to Mr. Edison. The Right Hon. Marquis of Salisbury's phonogram to Mr. Edison. Other phonograms of celebrities to Mr. Edison.

Musical Records (*Loud*).—American brass village band. English street brass band:—"May Bloom," "Right Away," "Dorothy." "God Save the Queen." Coach horn calls, by Prof. Goff. Post horn calls, by Prof. Goff. Cornet solos, "Mikado." Bagpipes, by a piper of the London Scottish Rifles. "The Whistling Coon," Eugene Stratton. Whistling à "La Belle Siffleuse."

Low Records.—Trio (cornet, violin and piano), American. Piano solo, "Helvetia Waltz," and improvisations, by Mr. Chas. R. Steytler." Piano solo, "Phonograph Valse," by Alfred Lee. Duets (cornet and piano, banjo and piano). Banjo solos. Comic song, "Two Lovely Black Eyes," in the English, French, German, Dutch, Hebrew and Greek languages, by Mr. Charles Coborn. Vocal quartet, by the Sisters Jonghmann. Vocal solos, "The Friars," by Mr. Pyatt. "Sewing, sewing," Mr. Bushell. Miscellaneous, containing:—Speech, song, laugh, cry, whistling, cough, imitations of various animals, &c. The phonograph's description of itself in rhyme. The phonograph's salutation. The first phonogramic poem spoken by the author into the phonograph, at Orange, New Jersey, U.S.A., June 16th, 1888, and received by Colonel Gouraud.

Besides these the Lord Mayor addressed through one of the instruments a short speech to Mr. Edison upon the establishment of the Institute, and in a few minutes the speech was reproduced with great clearness and accuracy.

The saloon of the Mansion House was illuminated by electric light supplied by the Electrical Power Storage Company, the installation consisting of 56 16 C.P. incandescent lamps (fixed), entirely maintained from a storage battery. The company also exhibited a number of appliances, including a specimen of its central station accumulators, such as are now at work at Westminster and other parts of London, at Taunton, Leamington, Norwich, Ipswich and Waterford, and also at Berlin; a ship-lighting cell such as is used for lighting in the British and Foreign Navies, on private yachts, &c.; an accumulator for train lighting—a very compact form of cell suitable for placing under the seats of railway carriages, and such as is used for lighting the trains on the Great Northern, Midland, London, Brighton and South Coast, London and North Western, and other lines of railway; a special type of accumulator suited for motive power purposes, such as driving electric launches, electric trams, and electrical omnibuses; a fully charged portable accumulator—a type of storage battery made for surgical purposes, which will maintain a 16 candle-power lamp for seven hours after full charge; a regulating switchboard for use in private house installations, by means of which the lighting of the lamps may be distributed between the dynamo and accumulators; samples of electric cable joints; a wooden model showing the latest form of E.P.S. accumulator plates, and a selection of photographs.

Mr. Pitkin, of Red Lion Street, Clerkenwell, displayed some beautiful examples of domestic, mining, and other handy, portable lamps. The Pitkin portable accumulator batteries are an improved form of lead secondary cell, constructed to give a maximum current in small space and with little weight. Among the examples shown was a 4-cell miner's lamp which weighs about 7 lbs., and gives a light of between 4 and 5 C.P. and of 12 hours' duration. The charging may be done with any suitable form of electric generator capable of giving 1 ampère with a potential of 10 volts for a period of eight hours. The amount of current used by the glow lamp is not more than ·5 of an ampère. Several other forms of these 4-cell batteries were shown, some with fixed plain glass lanterns or bull's eyes, others with detachable lantern and flexible wires for railway carriage reading purposes, others with a bevelled edge plain glass front with dull white silver reflectors. There were also some samples of table and reading lamps with their batteries. The capacity of each battery is just sufficient to last one evening. A number of attractive night clocks with electric lamp attachment was likewise exhibited, all worked by Pitkin cells. Some are brought into action for a few moments only by an ordinary electric bell push or pull, others are worked by means of switches. The railway reading lamp mentioned above is a peculiarly ingenious and handy contrivance, which is likely to come largely into use—if only the price be not too high for travellers. The battery is fitted into a leather case with a sling, and has all the appearance of a large opera or field glass. The lamp can be used either fixed to the case, or at a distance by means of a wire, the lamp being then attached to the user's coat by a hook, and the battery hung behind the back, or placed on the seat or even on the hat rack. Another exhibit was a very small surgeon's lamp and battery, suitable for microscopical and similar purposes; and among the more fanciful articles shown was an electric cigar lighter.

Mr. Apps, of 433, Strand, displayed a collection of highly attractive appliances. For example, a number of vacuum tubes, among which was a Garland tube of special interest, the pale mauve light of which in the constricted parts contrasted prettily with the deeper coloured and striated appearances in the bulbs forming the ring. There were several straight tubes containing bulbs, one in particular (formerly in the collection of the late Mr. J. V. Gassiot, F.R.S.) of great beauty owing to the peculiar striæ. Next a set of tubes rotating, attached to an electro-motor, produced a very fine effect. The colours were very bright, in considerable variety, and were repeated by reflection in the disc carrying them, which, though made of wood, appeared to have a surface as fine as jet. The combinations of colours and positions of tubes arising from the varying speeds of the motor and rheotome of the coil were very interesting (one visitor declaring that to watch the tubes almost produced a mesmerising effect.) There were also three magnificient coils exhibited, viz., a 12-inch, a 10-inch, and a 5½-inch spark. Respecting these I have only to say that they are of fine design, mechanically as well as electrically, in some cases the length of spark exceeding the length of the bobbin, and in reference to durability an instance is recorded of a coil being in daily use for 11 years with perfect preservation of insulation. Specimens of the Abbé Nollêt's globe and Gassiot's cascade were much admired—the former no less for its beautiful colours than the curious fact that it was illuminated by induction—there being no circuit through the vessel. Other exhibits by Mr. Apps were a rotation of sparks around a magnet in vacuo. At least three-fourths of the magnet was in the vacuum, and as the result a magnificent serpentine-like band discharge was obtained. On reversing the polarity the twist and rotation also changed. A set of resistance coils from ·01 to 100,000 ohms. One of Sir W. Thomson's galvanometers; a glass, one inch thick, pierced by the spark from the 4-feet spark induction coil designed and constructed for the late W. Spottiswoode, F.R.S., by Mr. Apps; two-prism spectroscope, as used in most chemical laboratories, and a series of vacuum tubes of special designs. There were a pair of garlands about 2 feet in diameter having within V. and R., a royal crown of elaborate design, and the name and address of the exhibitor finely modelled in white and uranium glass. All these tubes were illuminated in series from the 5½-inch spark coil.

BERRY'S ELECTRIC BELL.

FIG. 1 shows the electric bell ready to fix against a wall or stand upon a table, it is equally suitable in either place. The plated bell or dome is fixed in the centre of a well-turned and polished mahogany base with two lacquered brass terminals at the top, and two brass screw cups, one on each side, to take the screws which fix it to the wall. The whole of the working parts of the bell are hidden beneath the dome or bell itself and therefore cannot be tampered with without removing the top screw with a screw driver. It is neat, compact and ornamental in appearance.

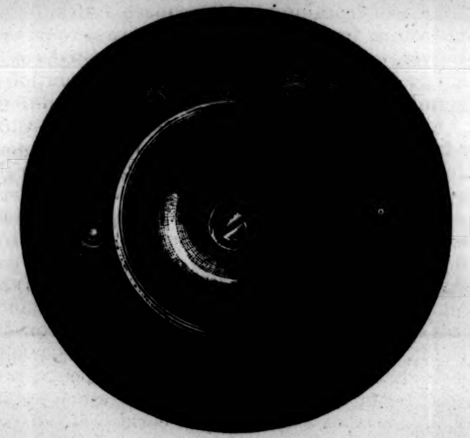

FIG. 1.

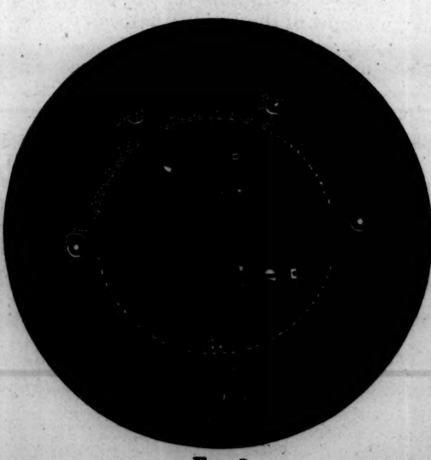

FIG. 2.

Fig 2 is a plan of the working parts, the dotted lines showing the position of the bell and the lug upon which the hammer strikes. The electromagnet consists of one bobbin only, with iron cheeks, the two cheeks forming the two poles which attract the small armature or hammer that strikes the bell. This bobbin is fixed upon the iron frame which also supports the bell or dome.

It rings very powferfully with one small Léclanche cell. The low price of this bell is arrived at by its simplicity of construction, the materials and workmanship being thoroughly good throughout. Considering the large demand there is at the present time for a good, cheap, and ornamental electric bell, we think, from a personal inspection, that this article will have its share of patronage.

THE DISCHARGE OF A LEYDEN JAR.

By J. GRAY, B.Sc.

PROF. LODGE in his recent lecture at the Royal Institution on the discharge of a Leyden jar, has added to our knowledge of electrical phenomena, and imparted new interest to one of the oldest and best known of electrical experiments. The phenomena of electrostatics, which received almost exclusive attention in the early days of electrical science, have been so much overshadowed by the later discoveries, in current electricity and magnetism, that they have come to be regarded as of comparatively little importance.

The discharge of the Leyden jar, as Prof. Lodge has pointed out, involves the consideration of the laws of electro-magnetism as well as those of static electricity; "and inasmuch as a Leyden jar is oscillatory, and we know the vibratory motion called light to be really an oscillating electric current, the domain of optics is seriously encroached upon."

This is a very sweeping and very fascinating generalisation, and implies a much more hopeful view of the state of our knowledge as to what electricity is than the recent dictum of another distinguished physicist (Sir W. Thomson), "that the difficulties are so great in the way of forming anything like a comprehensive theory, that we cannot even imagine a finger post pointing to a way that can lead to an explanation."

It appears that as early as 1842, the conclusion was arrived at by Henry, that the discharge of a Leyden jar did not consist of a flow of electricity in one direction, but of a series of oscillating discharges. This conviction was forced upon Henry by the fact that fine needles magnetised by the Leyden jar discharge, were found to be not always magnetised in one direction. In 1853 the theory of the oscillatory character of the spark was worked out completely by Sir W. Thomson; and since then several experimenters have confirmed his results. Prof. Lodge, finally, has shown in a new and most striking manner the existence of these oscillations. To explain the nature and laws of the oscillatory discharge in a popular manner, he has adopted one of those mechanical analogies with which he has made us familiar in his "Modern Views of Electricity:" the electricity is represented by an endless cord, pulled in one direction by a weight which represents the electromotive force, and in the other by a number of transverse stretched elastic cords which represent the dielectric. We have always thought that a closer parallel to the actual state of things might be obtained without detracting from its suitability for popular exposition, by adopting a hydrostatic analogy in which a fluid was employed to stretch the sides of elastic cells. These physical analogies are exceedingly useful for suggesting experiment, and the more complete they are, the more fruitful they are likely to prove. The laws of the oscillatory discharge were very beautifully illustrated by Prof. Lodge by means of a flexible lath fixed by one end in a vice. The flexibility of the lath was taken to represent the static capacity of the condenser, and the mass of the vibrating part of the lath to correspond to the self-induction or electromagnetic inertia of the circuit through which the discharge was to take place. Prof. Lodge in this analogy fails to distinguish between an increase of capacity which may be due to an increased surface of the condenser, and an increase of capacity which may be due to a decreased thickness of the dielectric, and an increase of the specific inductive capacity of the dielectric. A larger surface in the condenser will not change the flexibility of the dielectric, but will simply send a larger quantity of electricity through the external circuit at each stroke, and thereby increase the self-induction, or inertia, while a change in the specific inductive capacity corresponds to a change in the elasticity or flexibility of the dielectric. With this correction, the vibrating lath will show the conditions which determine the rate of oscillation. The rate of vibration of the lath may be diminished by loading the free end; or by increasing its flexibility, either by reducing its sectional area, or by making it of a more flexible material. Hence to reduce the rate of oscillation in the oscillating spark, we must increase the capacity of the condenser, and send the discharge through a considerable length of wire wound on bobbins to make the self-induction as large as possible.

Prof. Lodge has succeeded by these devices in lowering the rate of vibration till it comes within the limits of audition, and has, in fact, produced what he calls musical electric sparks. In some of these the rate of vibration is as low as 500 per second, which is a remarkable achievement, when we remember that in the ordinary Leyden jar discharge, the oscillations are to be numbered by hundreds of thousands per second. This low rate of oscillation enables the spark to be broken up by Wheatstone's revolving mirror, a result which was previously impossible on account of the extreme rapidity of the oscillations. An additional proof of the oscillatory nature of the spark was given by causing it to rotate the plane of polarisation of light, by passing it round a tube containing bisulphide of carbon placed between the polariser and analyser of a polariscope; the light transmitted was, in this case, shown to be intermittent by the revolving mirror.

Hertz, as we know, has shown that the discharge of an induction coil is oscillatory by means of the principle of resonance. Lodge has carried out similar experiments with the Leyden jar. A Leyden jar circuit when charged and discharged by an influence machine produced sparks in another circuit timed to the same rate of oscillation and placed at a considerable distance.

Prof. Lodge has, we think, by very original and ingenious methods, undoubtedly established the oscillatory nature of the Leyden jar discharge, under certain circumstances, and his results and methods we believe will not only be of immense theoretical interest, but also of great practical importance.

THE TRANSMISSION OF POWER BY ELECTRICITY.*

By FRANK J. SPRAGUE.

THE transmission of power by electricity is now an established fact, and every day, for the ordinary uses of life, its application is rapidly spreading. The principles of its application are well settled. The dynamo and motor have been brought to a remarkably high efficiency, and leave little to be desired as converters of energy. The future of the transmission of power from central stations, under ordinary conditions, is a matter of commercial development. The special application of the transmission of energy over long distances depends chiefly upon the demand which exists for such transmission and the intelligent application of principles already well known. Distance is a relative term. It does not seem a difficult matter to transmit 5 horse-power 10 miles, but a gigantic problem to transmit 1,000 horse-power one mile; the latter appeals to our imagination, and yet the former is, in one sense, the more difficult problem, not so much because of any difference in the general principles involved, as in the fact that in the construction of machines of high electromotive force we meet with more serious difficulties in the matter of insulation and the element of personal danger to the operator.

It is not my intention to enter into any general discussion of the question, nor to go into the particulars of dynamo and motor construction, for the limits of this paper would not permit this; but I shall briefly point out the different phases which the transmission of power by electricity may assume, show some of the general conditions which must be met, emphasise the practicability of such transmission, and then more particularly discuss a new method for the determination of the elements of a single transmission which my own practice has brought out, and which I have found it advisable to adopt. I shall here consider only the use of a continuous current and a direct transmission.

For the purpose of this paper we may consider the following cases of transmission:—

(1) Transmission from a central station conveniently situated near the centre of a manufacturing district, over an area of from one to 100 square miles, in units varying from a fraction of a horse-power to 50 or 100 horse-power. Such a system is illustrated by the Edison two and three wire circuits in operation in a large number of cities in the United States. Referring to my own work alone, its practicability is illustrated by the fact that in Boston I have nearly 150 motors in operation, in New York about 125, and in New Orleans nearly 100; there being in various stations not less than 1,200 machines, varying from a half to 30 horse-power, and used in no less than 130 different industries. These machines are operated under potentials varying from 100 to 440 volts, and are run on constant potential circuits. The maximum distance in this class of work is, at present, about 1 mile on a 220 volt circuit, and the practical limit for this potential from a single station is about 4 square miles.

In considering how far this central station work can be carried, we must bear in mind certain facts; power transmitted means the transference of an energy whose value may be expressed, as in all cases of fluid transmission, by the product of the quantity and pressure—that is, by the product of the electromotive force and the current. With any given amount of energy transmitted, the electromotive force and the current will vary inversely. The laws of distribution are clear. With any given work done, loss on the line, electromotive force at the terminals of the motor and distribution, the weight of the copper will vary as the square of the distance, its cross section, of course, varying directly as the distance. With the same conditions, the weight will vary inversely as the square of the electromotive force used at the motor. With the same cross section of conductor, the distance over which a given amount of power can be transmitted will vary as the square of the electromotive force. If the weight of copper is fixed, with any given amount of power transmitted and given loss in distribution, the distance over which the power can be transmitted will vary directly as the electromotive force. Hence, if it is practical to economically transmit power 1 mile under 200 volts pressure—that is, if the investment in copper is not disproportionate—then, by increasing our pressure to 800 volts, we can transmit this power 4 miles without changing the ratio of the investment. I am now speaking of the use of a bare wire and assuming that the cost of stringing the 4 miles of given weight of wire is no more than stringing an equal weight 1 mile. Of course this is not strictly so. As a matter of fact, however, it is a practical thing to transmit and deliver over an area of 100 square miles, from one central station, under a pressure not exceeding 1,000 volts; and the larger the amount of power distributed and the greater the number of units, the more cheaply it can be done. The question arises, "Would it be economical, in a district of this character, to deal with the larger horse-powers?" My answer is unquestionably "Yes." It is true that the actual efficiency of double conversion would vary from 50 to 70 per cent., depending upon the distance and the pressure used, but experience has developed the fact that not over about 35 to 40 per cent. of the maximum capacity of all the machines in a circuit represents the average duty demanded; and since this is so, it follows that the amount of power that can be contracted for will at least equal, probably considerably exceed, the steam power in the central station. I say "steam power" because in a large majority of cases in this kind of transmission steam and not water will be the prime source of energy. When we consider the economy of operating a large, well-designed and properly constructed steam plant, and the great advantage to the user where the electric motor replaces the ordinary steam engine, it does not need a very shrewd commercial sense to see the advantages of this method. In fact, there is not a city in the United States, no matter how numerous its factories, which could not have them run better than to-day by a well-constructed electrical plant, working under pressures which would not be dangerous to life.

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* A Lecture delivered before the Franklin Institute, November 12th, 1888.

(2) Somewhat analagous to the system we have just discussed is the transmission at constant potential with the motors applied with various loads at constantly varying points. Such a system of transmission is that which exists in the parallel circuit system for railroad work. There are now in the United States alone no less than 60 or 70 electric railways in operation or under construction. The most extensive of these, up to the present writing, is the Richmond Union Passenger Railway, whose characteristics may be cited as an illustration. This has about 12 miles of track and is operated under a pressure of about 450 volts. The central station has a capacity of about 375 horse-power. The farthest point reached is about three and one-half miles from the station. The equipment consists of 41 cars, with 82 machines whose aggregate normal capacity is between 600 and 700 horse-power, nearly double the steam capacity. The car units develop anywhere from nothing to 20 horse-power. The maximum load which has been put upon the system at one point at any time is the starting of about 22 cars about two miles from the station, requiring, probably, about 125 to 150 horse-power. The road now having made nearly 600,000 miles, the practicability of this kind of transmission may be accepted as an assured fact.

3. The transmission from one station to another, at which latter point are a number of independent machines, each of which has a variable load and is required to run at constant speed. An example of this is the transmission from a water-power to a stamp mill, where the different batteries of stamps are operated by independent machines. The most satisfactory method is to maintain at the receiving station a constant potential, and to use for the receiving machines motors wound to be self-regulating, according to the laws which I gave some time since. The dynamos should either be compound wound or the field regulators adapted to increase the electromotive force of the machine as the load increases. Constancy of prime speed is an essential; or, if it does not exist, then there must be a combined mechanical and electrical governor which will assure a definite electromotive force, which shall correspond to each variation of the current.

4. The transmission between two stations as last mentioned, save that the condition of automatic regulation is not essential. In this case the dynamos may be either shunt, compound, or series wound, and the motors either shunt, cumulative, or series. Such a plant is now running in one of the mines at Aspen, Col. The electromotive force there used is about 450 volts and the distance somewhere about a mile.

5. Transmission with a single line over a long distance, with the motors distributed throughout the entire line. This is a case which may occur in some manufacturing districts, but is more apt to occur in such work as canal building, dredging, or mining in river beds. It can be accomplished by the use of a constant current circuit, using constant current motors, or with the same aggregate electromotive force on a constant potential circuit. A marked case is the mining operations carried on at the Big Bend Tunnel of California, in a large river canon, where about a dozen machines, developing from 5 to 10 horse-power, are used for operating pumps and derricks, and are supplied by two lines of from 600 to 1,000 volts potential over a distance of about eight miles from the central station.

Thus far I have considered the distribution with a practically constant potential at the motors, and the parallel method of distribution, as distinguished from the constant current method, where the motors are in series. This last for large powers and many machines, is a limited and unnatural method, the former a comprehensive and natural method, which facts are entirely independent of the question of relative electrical potentials or currents, because, on constant potential circuits, we can work at 100, 1,000, or 5,000 volts if we choose.

Among some of the special cases of power transmission I will briefly note the following:

6. The transmission from one point to another, using two series wound machines, where the motor has a constant torque or a load per turn. The motor being at rest, as the electromotive force of the generator is raised by increasing its speed, or by increasing the resistance of a shunt around its field with any given speed, the current, which may be expressed by

$$\frac{E}{K}$$

will increase until the torque is great enough to start the motor against its load, when the current will become stationary. A motor electromotive force being now created, the current is expressed by

$$\frac{E' - e}{K} = \frac{E}{K}.$$

Any increase of the electromotive force of the generator will be followed by an equal increment in the motor electromotive force, the difference between the two, and hence the current, remaining perfectly constant. The speed of the motor being known for one electromotive force and load, its speed for any other electromotive force may be determined, and fast or slow hoisting be regulated entirely at the generating station.

(7.) The transmission to one point from another, with a single generator and a single motor with variable loads, presents two solutions. The first is the use of the compound dynamo and differential motor; but a far more interesting solution is the use of two series machines which, when properly proportioned, became self-regulating. I will briefly touch upon the theory of this method of transmission. We have the condition that the same current passes through each field and armature, and also the condition that the speed is constant, while the work is variable. Since work may be expressed as a product of speed and torque, and since the speed is constant, it follows that the motor torque must vary directly as the work. Again, we have as an expression for the work done the product, e C. Since the speed of the motor is constant, e must vary directly as the strength of the field, which, where the magnetisation is low, will vary directly as the current, and when more highly magnetised in a much less degree. E being E.M.F. of the generator, and K the resistance of the circuit, we have:

$$C = \frac{E - e}{K},$$

and, as we have already stated,

$$E \text{ varies as } e, \text{ as } E - e, \text{ as } C,$$

and work

$$\text{varies as } e\,C, \text{ as } C^2, \text{ as } e^2, \text{ as } E^2.$$

The dynamo likewise being driven at a constant speed, E likewise varies as the strength of its field. If m equal the number of turns of wire in the dynamo field, and n those in the motor field, then the ampère turns or magneting forces are expressed by m C, and n C. It follows from what proceeds that the magnetisations due to m C, and n C, should vary in the same proportion; in other words, the characteristics of the generator and the motor must be similar between the limits of the variation in load. Should the machine used be improperly proportioned, then the regulation can be largely determined by putting a resistance in the line circuit, or shunting one or other of the fields with a resistance. The electrical efficiency of the circuit being

$$\frac{e}{E},$$

we have the following fact: That the electrical efficiency is a constant for all loads with the limit of automatic regulation. If the machines are of the same general type, then, when correctly proportioned, the ratio of their weights and watt capacities should be the same as the electrical efficiencies of the circuit.

8. As a modification of the proceeding, especially where large powers, long distances, and necessarily high potentials are used, it is advisable to divide the generators and motors into a battery of machines of identically the same weight and character, the number of the machines being the ratio of the electrical efficiencies, the generators all to be driven from the same line of shafting, and the motors to drive on to a common line, and the current to pass through all the machines in series. This I consider the only sound method when dealing with large powers and high potentials and single units of generation and recovery, especially where automatic regulation is required. Its advantages are manifest. One of the greatest difficulties which we have in dynamo-electric construction in closed-circuit machines, especially where using the drum system of winding, is the difficulty of securing perfect insulation when high potentials are used.

One thousand or 1,200 volts seems as high as it is now advisable to go in machines of this type, where currents of any magnitude are to be used. In the transmission of electricity reliability is an essential, and a potential of 3,000 or 4,000 volts, distributed over three or four machines in series, is, despite the increased number of machines, far less liable to cause failure than where put into one machine of the aggregate size of the four; and in the event of the breaking down of one machine, the units may be so proportioned that by a corresponding change in the units at the other station, or a proper variation of the regulating shunt to the fields, it becomes quite possible to continue automatic operation. As an illustration of this distribution of machines, if wishing to use dynamos and motors of an electrical efficiency of about 95 per cent., a commercial efficiency each of about 90 per cent., and with about 60 per cent. as the total commercial efficiency of the circuit, I would, with a distance of about nine miles, use five series machines identical in construction, each wound for about 1,200 volts, three of which machines would be driven by a common line of shafting at the generating station, and two driving on to a common line of shafting at the receiving station. It will be noticed that both in the single and multiple unit series system the electromotive force and the current vary equally. I hope at an early date to be able to show this last system in practical operation.

The indirect methods of transmission, such as through a secondary battery of generators, motor generators and secondary batteries, I will not here discuss.

I come now to the consideration of some new, interesting and very practical formulæ for determining the elements of a single transmission of a given amount of power. Before entering upon its discussion, it is necessary to state why I differ somewhat from the methods which have hitherto been published.

(*To be continued.*)

Hotel Lighting.—The spacious public halls, rooms, and corridors of the North-Western Hotel, Liverpool, which belongs to the London and North-Western Railway Company, are now illuminated by 250 Edison-Swan lamps. The work has been carried out by the Liverpool Electric Supply Company.

A TENDER SPECIMEN.

[A COMMUNICATION.]

A SHORT time ago the Berlin representative of a very well known English electrical manufacturing firm was told by a German professor that "electro-technology is in a far more advanced state in Germany than in England." The art of tendering for electric light installations has evidently been well cultivated there also, as the following extracts may show. They are taken, as literally as translation will allow, from a tender recently made for central station plant to a company in the South of Europe by the local representative of an eminent German firm. A competing English tender won in this case, however. After a complimentary beginning, the tender reads:—"Before I enter on the exposition of the proposal which I promised to present, permit me to declare very frankly that my proposal will not give me profits. I have made it solely my view to furnish good apparatus and perfected mechanism for equitable prices, so that you may be able to raise in this important city a new and modern standard of glory to the prodigious invention of the eminent Volta.

"I am one of the most fervent admirers of the electric light, though the humblest of all, and my greatest desire would be to be able to establish this marvellous light in the principal part of this hospitable country that was not my cradle, but that has been to me an indefatigable protector."

The following paragraph sets forth that the tenderer only desires to take a large part in the valuable installation which the company intends to make: "To me that will suffice." The dynamo specification reads:—

"Two dynamo-electric machines, double compound, automatically regulating the current, system ——, of 38,500 watts power each one, or 77,000 watts total, speed only 550 revolutions per minute, with drums of 34 centimetres in width by 50 cms. in diameter, with their shafts of steel, armatures of soft iron, collectors (not of copper) of an alloy of metals of a hardness that avoids their rapid deterioration. The sections of which they are composed are insulated with incombustible materials, such as asbestos, &c.; besides this, these collectors are placed in such a manner that others may be substituted for them with the greatest facility, when this becomes necessary. The brushes are movable in their supports to diminish or augment the current, and are provided with adjustment springs to regulate their pressure upon the collectors.

"All the brushes are galvanised. In the price is included the key, spanners, automatic lubricators, speed indicators—in fact, whatever is necessary and required for dynamos proper for an installation of this order. The dynamos can furnish light for 320 lamps of 16/20 C.P. 'Siemens,' or 1,000 to 1,200 Swan or Edison. [This is inexplicable.] I repeat that the revolutions necessary to produce this amount of light are only 550 per minute, and this is one of the principal advantages of this machine over the greater part of those known, as it will easily be understood that so many fewer revolutions there are so much less will be the friction, and, in consequence, less the deterioration of the shafts and bearings; and the five catalogues herewith, with their descriptions of all the installations made by —— speak better of these advantages. He has realised very numerous advantages, and among them some that well merit especial attention. Among them we cite the two realised in —— and —— with 4,700 incandescent lamps and 133 arc lamps.

"*Fans.*—Two apparatus for the ventilation of the rings and connections of the dynamos, worked by steam, with their belongings."

The specification for the apparatus of the test room needs prices attached to show its full beauty. It reads as follows:—

One apparatus to measure resistances ...	£3
„ differential apparatus	6
„ portable voltameter (*sic*)	9
„ very sensitive galvanometer	31
„ apparatus of great sensibility to measure the resistances in the circuits	£35

Connection from the dynamo to the switchboard made of copper of high conductivity, insulated with gutta-percha, in tubes of vulcanised India-rubber."

This last item would suit some of our friends who are discussing "installation insulation." The mechanical specification has some good points, too.

"Two tubular boilers of to-and-fro (or, literally, "go-and-come") fire, of the most modern construction, duly tested and legalised by the documents of the competent authorities. . . . ."

"Two engines of high pressure, velocity of 200 revolutions per minute, for the regular work of 60 to 70 horse-power. Well able at will to carry much more, with 6 atmospheres pressure each one. With two cylinders and two powerful flywheels, to avoid the prejudicial effect of the deadpoint upon the motion of the dynamos; with pressure gauges in the steam chests; perfected governors. These engines are specially constructed to run the dynamo machines, and as those of the system ——— demand only a low speed, the engines also only require a speed relatively low, which is most important, because from this results an enormous economy in all the plant, and in the lubricating material. This is the most valuable of all the improvements in the ——— apparatus."

The above are the finest extracts from the tender. It so happened that the directors had good technical advice, and so were not taken by the flowing literary style and the disinterestedness so touchingly displayed. The order came to England, but the German agents in this business, as in others, know how to use personal influence, and to gradually talk over, with much patience and tact, people who are not at all disposed to give them orders at first. In this, as in other branches of commerce, British goods hold their own when fairly compared; but the British producer allows himself to be very badly served in the matter of agents and travellers.

Perhaps he is waking up, but at present there are few signs of the electrical fraternity pushing for foreign trade. In such things as bells French and German goods hold the market, the dealers not knowing even the names of English manufacturers. This is not as it should be. Let the Electrical Section of the Chamber of Commerce enquire into it.

ARC LAMPS AND THEIR MECHANISM.*

By PROF. SILVANUS P. THOMPSON, D.Sc., M.I.E.E.

(*Continued from page* 304.)

FEED MOTIONS.

[i.] *Rack and Train* controlled by—

(a.) Star wheel and detent. [Staite, 18,783, 1847; Foucault-Duboscq; Serrin; 653, 1858.]
(b.) Fly and detent. [Staite, 1848; Duboscq, 1855.]
(c.) Brake-wheel and brake. Chapman, 739. 1855; Crompton, 346, 1882.]
(d.) Escapement with pendulum or balance and detent. [Siemens 4,949, 1878; Hardman, 3,166, 1881; Waterhouse, 5,185, 1881.]
(e.) Escapement and paddle. [Waterhouse, 5,185, 1881.]
(f.) Governor with detent or moderator. [Waterhouse, 5,185, 1881.]
(g.) Magnetic brake wheel or detent. [Brockie, 1,713, 1882; Harling, 3,473, 1881.]
(h.) Liquid brake. [Hopkinson, 153, 1881.]

[ii.] *Clutch or Clamp on Rod.*

(a.) Tilting ring, tilting eyelet, &c. [Slater and Watson, 212, 1852; Brush, 2,003, 1878; Lumley, 1,249, 1882; Lever, 2,092, 1882; Thomson-Houston; Waterhouse, &c.]
(b.) Split cone gripped by fork. [Slater and Watson, 212, 1852.]
(c.) Split nozzle forced into cone mouthpiece. [Bürgin, 4,820, 1881.]
(d.) Split tube held together by oblique levers. [Rogers, 3,236, 1882.]
(e.) Gripping springs at side. [Lever, 3,599, 1881; Munro, 1,626, 1882.]
(f.) Gripping fingers. [Roberts, 14,198, 1852; Joel, 5,157, 1879; "devil's claws," Harding, 3,166, 1881.]
(g.) Washer jambed by ball bearing. [Young, 1,689, 1882; or roller, Newton, 4,559, 1881.]
(h.) Tilting clamp or nipping clamp. [Common, 626, 1882.]
(j.) Nipping lever. [Grimstone, 1,670, 1881; Mondos, 5,490, 1881.]
(k.) Scissors lever. [Joel, 3,970, 1884; Jarman, 563, 1882; Gerard-Lescayer, 2,992, 1882.]
(l.) Spiral spring surrounding rod. [Keilhotz, 1886; Thouvenot, 1887.]
(m.) Forward-pointing springs (lobster trap). [Newton, 1,623, 1883; Clark-Bowman, 1,182, 1883; Holmes, 769, 1886; Hawkes, 157, 1882.]

(iii.) *Clutch-wheel or Brake-wheel.*

(a.) Nipping lever outside brake-wheel. [Gramme, 1861; Common and Joel, 1,040, 1881; Brockie, 4,419, 1882.]
(b.) Nipping lever inside rim of wheel. [Union Co., 392, 1882; Brockie, 4,419, 1882.]
(c.) Elastic band brake. [Statter, 2,985, 1885.]
(d.) Elastic internal ring brake. [Siemens, 6,987, 1887; Fein, 1888.]
(e.) Wheel lifted against brake or detent. [Bürgin, 4,820, 1881.]
(f) Brake-wheel lifted upon brake lever. [Gumpel, 253, 1881; Crompton-Crabb, 2,539, 1883.]
(g.) Friction pad on rim of wheel. [Abdank, 1882.]

(iv.) *Screw Motion.*

(a.) Screw worked by weight of upper rod. [Hopkinson and Muirhead, 153, 1881; Cance, 3,976, 1881; Akester, 2,419, 1882.]
(b.) Screw worked by motor. [Tchikoleff, 1874.)
(c.) Screw worked by step-feed. [Street-Maquaire, 9,666, 1885.]
(d.) Screw worked by vibrated wheel. [Siemens, 6,987, 1887.]

(v.) *Cord and Pulley Motions.*

(a.) Cord and pulley to core of solenoid. [Archereau, 1848; Jaspar, 83, 1879.]
(b.) Cord and pulley connecting carbons, with long-travel solenoid. [Pilsen lamp, 1,397, 1880; Doubrava, 1,033, 1886.]
(c.) Cord gripped by controlling cam. [Harding, 4,590, 1879.]
(d.) Cord and pulley for differential feed. [Weston, 1883, Kennedy, 1888.]

(vi.) *Step-by-Step Motions.*

(a.) Step detent worked by electro-magnet. [Deleuil, 1856; Brockie, 898, 1882; Gatehouse and Kempe, 2561, 1882; Kennedy, 5524, 1881.]

[vii.] *Magnetic Clamps and Clutches.*

(a.) Tilting magnet clutch on rod. [Roberts, 14,198, 1852; Gülcher, 2,038, 1881.]
(b.) Magnetic clamp on brake-wheel. [Harling and Hartmann, 3,473, 1881; Hardt. 1886.]

[viii.] *Electric Motor Action.*

(a.) Motor screws carbon up or down. [Tchikoleff, 1,874 and 2,198, 1881; Maquire, 1889.]
(b.) Winds up with cord or rack. [Andrews, 2,321, 1879; André, 2,764, 1880; Bousfield, 523, 1879; Breguet, 1879.]
(c.) Motor itself controlled by shunt magnet. [Thomson-Houston, 315, 1880.]
(d.) Motor with copper damper. [Thury, 1888.]

[ix.] *Hydrostatic and Pneumatic Action.*

(a.) Carbons controlled by admission of liquid or gas. [Lacassagne and Thiers, 2,456, 1856; Hopkinson, 3,509, 1880; Leibold, 1886; Sedlaczck, 1883.]

[x.] *Vibrating Feeds.*

(a.) Make-and-break lever vibrate forward-pointing springs. [Newton, 1,623, 1883; Pieper, 4,647, 1885; Holmes, 769, 1886.]
(b.) Make-and-break lever actuates escapement. [Harding, 3,166, 1881.]
(c.) Make-and-break lever actuates detent on train. [Gramme, 1880.]
(d.) Make-and-break lever hammers rod through clutch. [Letang, 5,509, 1887.]
(e.) Make-and-break lever works internal clutch-wheel feed. [Fein, 1888.]
(f.) Make-and-break lever drives pallet and screw feed. [Siemens (Alteneck), 1885.]

[xi.] *Periodic Feeds.*

(a.) Periodic drop of upper carbon and lift through definite range. [Brockie, 898, 1882, and 1,713, 1882.]
(b.) Periodic currents to magnet sent through second wire. [André, 4,948, 1881.]

[xii.] *Continuous Feeds.*

(a.) Clockwork step feed, length of stroke varied by magnet. [Brockie, 898, 1882.]
(b.) Pendulum or governor, having rate varied by magnet. [Waterhouse, 5,185, 1881.]
(c.) Rack-train controlled by magnetic retardation on copper wheel. [Niaudet, 1878.]

[xiii.] *Hammering Feeds.*

(a.) Rod driven through clutch by vibrating hammer. [Letang, 5,509, 1887; Capito and Hardt, 1887.]
(b.) Ditto, by tilting lever. [Jolin, 2,570, 1883.]
(c.) Ditto, by magnetic pile-driver on rod. [King, 1888.]

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* Read before the Society of Arts on Wednesday evening, 6th March, 1889.

Outside the classification adopted above are several well-marked features of mechanism; one of these is the *parallelogram motion.* A typical case of this is afforded by the well-known Serrin [653, 1859] lamp (fig. 5). A jointed parallelogram is constituted by the pieces which meet at A, B, C, D. The side, A, C, is fixed, being part of the frame, whilst the levers, A, B, C, D, rise and fall through a small angle, carrying with them the upright, B, D. To this upright is fastened a sleeve, through which the lower carbon holder passes. This moving parallelogram is held up by a spring, S. When the electromagnet, E (in main circuit), attracts its armature, *a*, the parallelogram, and with it the lower carbon, sinks, and so the arc is struck. At the same instant a projecting triangular detent, U, engages against a star wheel of the driven train and locks it, so that the upper carbon cannot descend. As the carbons are consumed the current is weakened, owing to the increasing resistance of the lengthening arc, and the electromagnet lessens its attraction; consequently the parallelogram gradually rises, until a moment occurs when the detent ceases to lock the star wheel. The upper carbon holder is now free to descend a little, driving the train of wheels, shortening the arc, restoring the normal current, and so again causing the electromagnet to pull down the parallelogram and lock the wheels. Parallelogram motions are to be found also in Bürgin's lamp [4,820, 1881], and in Siemens's pendulum lamp [4,949, 1878].

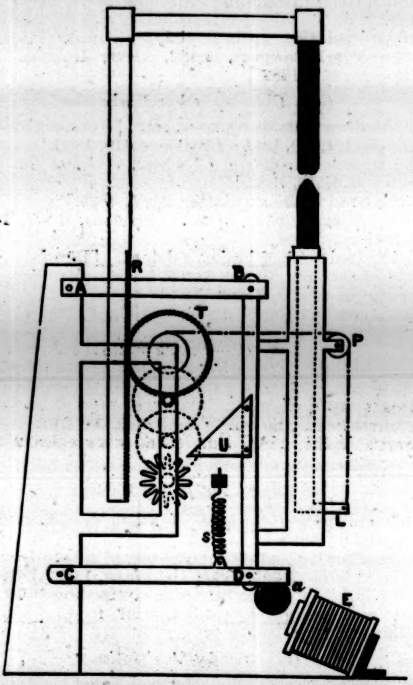

FIG. 5.—SERRIN'S LAMP.

Another characteristic mechanism is the *see-saw* lever. Fig. 6 shows the form used in the Brockie-Pell lamp [12,681, 1885]. The earliest use of the see-saw, attracted at opposite ends by series and shunt magnets respectively, occurs in the lamp of Lacassagne and Thiers [2,456, 1856]; whilst modern examples are Weston's lamp, the Thomson-Houston lamp (fig. 14), and Fein's lamp of 1883. [Also Moffat and Chichester, 3,441, 1881; and Chadburn, 2,755, 1881, where the see-saw works a clutch.] A compact modification of the see-saw mechanism occurs in one form of Weston's lamp, and again in Kennedy's lamp of 1888, fig. 10. Here the lever is replaced by a pulley over which passes a cord or ribbon of metal. In this lamp the shunt solenoid is furnished with a plunger core, whilst the series solenoid on the left has a plunger and an external iron mantle to increase its power. The smaller pulley communicates the motion to a clutch. The advantage of the see-saw, and of its pulley equivalent, is that such an arrangement enables the lamp to be used as either a constant potential lamp or as a constant current lamp. In the former case the shunt coil holds up its end, whilst the see-saw is operated by the variations of the current in the series coil. In the latter case the actions are the inverse of this.

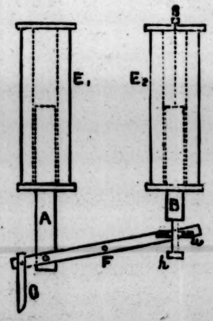

FIG. 6.—SEE-SAW OF BROCKIE-PELL LAMP.

The *rack-train* mechanism which forms the first class in the preceding list, presents two special points. As this mechanism is in itself non-retractile, and can only propel the carbons forward, it cannot be used with non-homogeneous carbons of second quality, unless special provision is made in the striking mechanism of the lamp for a retractile movement. There is nothing retractile, for example, about the Breguet lamp (fig. 3), but there is about the Serrin (fig. 5), for the lower carbon holder (which descends to strike the arc) is never held tight down by the electromagnet, but takes up a position of equilibrium. The other point is that in these rack-train lamps some device is requisite to lock the train at the instant of striking, otherwise the feed motion would neutralise the strike motion. In some lamps [Breguet, Sellon, &c.] there is a mechanical connection from the striking part to lock the feed. In some other lamps the action is performed electrically. In the De Puyt lamp (fig. 24), a pin on the train frame engages with a forked connecting piece from the feeding lever.

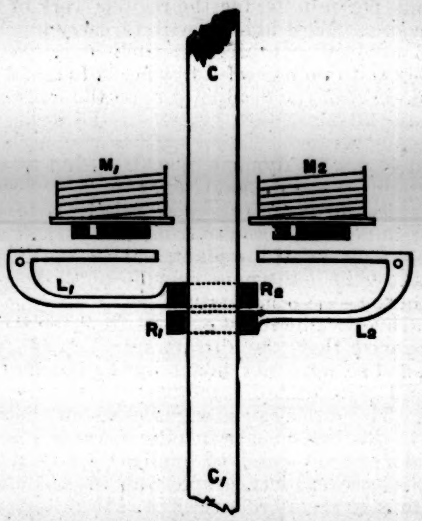

FIG. 7.—SLATER AND WATSON'S CLUTCH.

A characteristic arrangement, applicable to rack-train lamps, is that in which, for the purpose of striking the arc, the whole train mounted in its framework, together with the rack and the upper carbon rod, is bodily lifted by the use of an electromagnet in the main circuit. [Crompton, 346, 1882; Fyfe and Main, Hochhausen, Gümpel, Berjot, Wood, Maxim, &c.] More neat is the method of rocking the train bodily around the axis of one of the wheels of the train. [Brockie, 2,370, 1882; and De Puydt, fig. 23.]

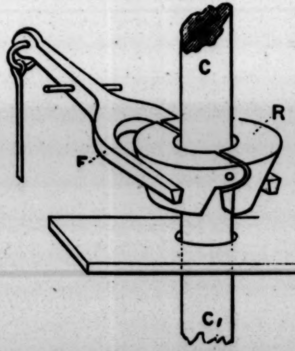

FIG. 8.—SLATER AND WATSON'S SPLIT CONE.

Passing from the *rack-train* lamps to the *clutch* lamps, it may be noted how much ingenuity has been expended in attempting to find a form of clutch which will prove reliable under all conditions of working. Two of the very earliest forms of clutch mechanism are worth recalling in this connection. These are both due to Slater and Watson [212, 1852]. The first (fig. 7) shows a carbon rod sliding through a couple of rings or eyelets, which are tilted by the attraction of an electromagnet to grip and raise the rod. In the second (fig. 8) the clutch consists of a split conical washer, the two halves of which are hinged together. These are compressed by the rising of a fork, which nips and raises them. The tilting ring introduced by Brush is too well known to need comment. Lever's modification of the tilting ring is shown in fig. 9, the rim below the ring causing the thrust to act more obliquely at first, and allowing the clutch to work even when the aperture is considerably worn. In the latest forms of this clutch, the ring has a tail piece which is hinged to the frame of the lamp. Another successful form of tilting clutch is shown in fig. 10, which represents the mechanism of Kennedy's lamp. The clutch has a long tail, provided with an adjusting screw to regulate its position, and bears against the carbon rod by a slender spring, *s*, above. It is worked by a thin cord, *d*, running over a pulley in connection with the differential arrangement of shunt, S, and series, M, solenoids described above. A clutch provided with a spring that bears against the carbon rod is also found in the Clark-Bowman lamp [1,182, 1883], the feeding in this case being accomplished whilst the clutch is held up, by giving to it a mechanical vibration. In the Kennedy lamp the spring on the clutch also serves the purpose of finally arresting the descent of the carbon holder, catching on a groove cut around its upper end when the carbon pencil is all consumed. Another simple clutch with spring mounting, worked by the mutual repulsion between two similarly magnetised cores, has been devised by Swinburne [11,893, 1886]. Clutches of the knee-lever type have been devised by Lorrain [183, 1883] and Joel [3,970, 1884]. The more complex "scissors joint" levers, used in one of Joel's lamps, are drawn in fig. 11. Their action is obvious, as their upper end s raised by the upward pull of the electro-magnet or solenoid; they grip, and raise the carbon rod, and they relax their grip on being lowered to feed the arc. Very similar devices are found in Gerard's and Jarman's lamps. An ingenious species of clutch, by F. M. Newton [4,559, 1881], is illustrated in fig. 12. This consists of a ball bearing or roller bearing, which on the raising of the collar in which it lies jams against the carbon rod and raises it. Another extremely simple clutch [Lorrain, 689, 1883], consists of a plunger working horizontally through a solenoid, pressed sideways by a spiral spring against the carbon rod; the pressure of this is taken off, when feeding is required, by the pull due to the current in the solenoid, which is connected as a shunt. Rogers's [3,236, 1882] simple and very efficient form of clutch consists of a split tube, the parts of which are connected together by a pair of oblique links, making a sort of parallel motion. This form is shown in fig. 13.

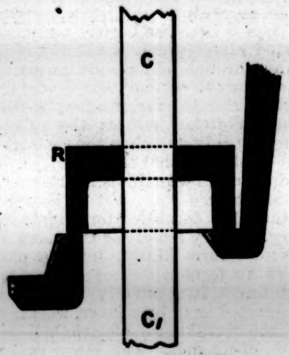

FIG. 9.—LEVER'S CLUTCH.

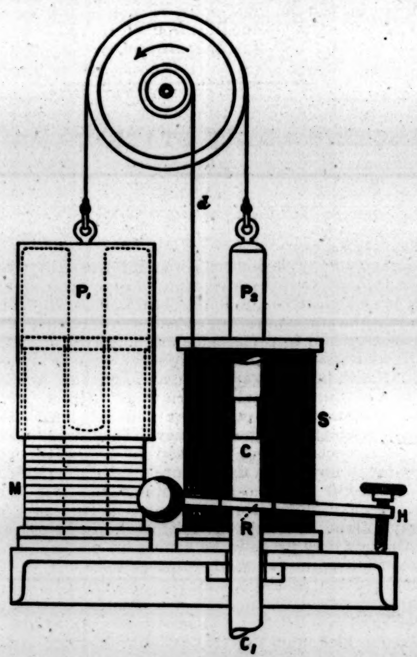

FIG. 10.—KENNEDY'S LAMP.

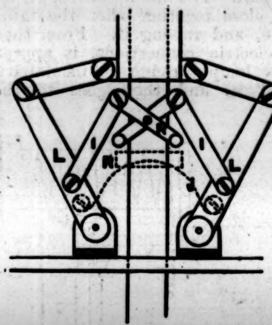

FIG. 11.—JOEL'S SCISSORS JOINT.

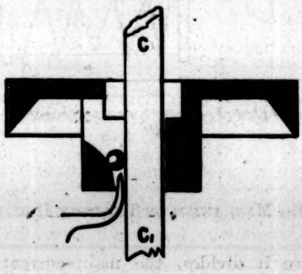

FIG. 12.—NEWTON'S ROLLER CLUTCH.

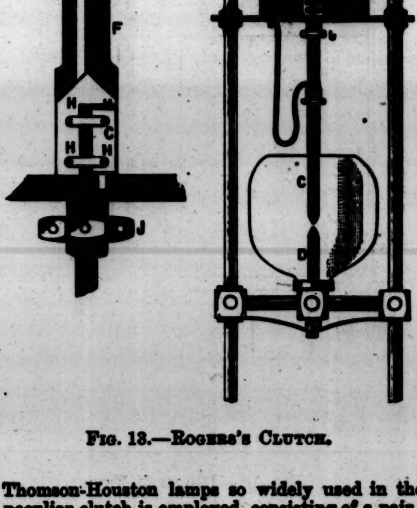

FIG. 13.—ROGERS'S CLUTCH.

In the Thomson-Houston lamps so widely used in the United States, a peculiar clutch is employed, consisting of a pair of levers jointed together, one of them being perforated with an eyelet through which the carbon rod passes. The mechanism of this lamp, shown in fig. 14, consists of a see-saw lever, L L, pivotted at O, and provided with a long tail, T, the motion of which is moderated by an air dash pot. Below is an electro-magnet, M, in the main circuit, and above is a second, S, which is connected as a shunt. The pole pieces of both are of conoidal shape, protruding through apertures in the armatures, *a a*, and *b b*, to give longer range of pull. The lower and upper arms of the clutch, marked B and E, close together when the tail, T, rises, gripping the carbon rod, C, and raising it. From this diagram, which also shows the electric connections, it appears that the current entering the lamp through an insulated terminal at + P, flows first round M, and then goes to the frame of the amp. Thence it divides, the main current finding its way to the upper carbon holder, and so through the arc to the lower carbon, whence it returns (by a route not shown) to the insulated negative terminal, – P. A smaller portion of the current flows up round the shunt electro-magnet to – P. The arc is struck by the preponderating main-circuit current in M attracting the lever end of the see-saw lever, and raising the clutch. The feeding is accomplished by the preponderating pull of the shunt magnet as the arc increases in length. The resistance wire across from + P to *c* constitutes a cut-out circuit, which is brought into operation by the augmented current in S on any failure of the main current. The small coil connected across from + P to the lamp frame is a mere adjustment to regulate once for all the power of the series coil, *m*, relatively to that of the shunt coil, S.

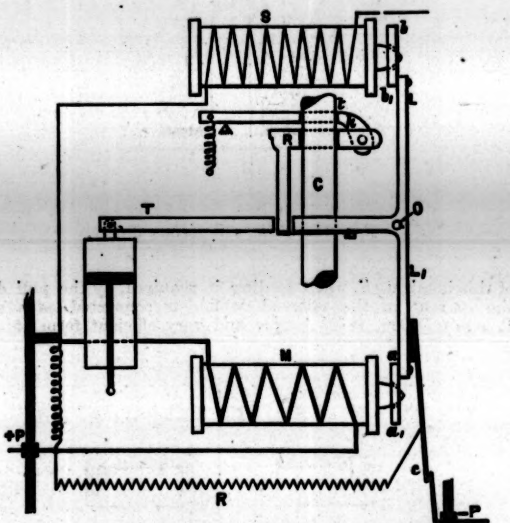

FIG. 14.—MECHANISM OF THOMSON-HOUSTON LAMP.

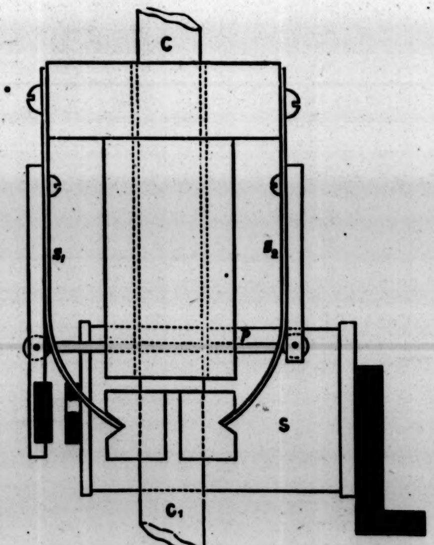

FIG. 15.—HOLMES'S FEED.

It will be noted that in the operation of all these clutch actions there are really four periods. In striking the arc there is a first stage of affairs, where the clutch rises sufficiently to grip the carbon rod, immediately followed by a second stage, during which it rises still further, and lifts the carbon rod, so striking the arc. During the third stage or period the clutch still retains its grip, but as the arc burns away the clutch is gradually lowered. This is due, in constant potential lamps, to the weakening of the main current; in constant-current lamps, to the increasing opposing action of the shunt. The fourth stage is reached when the arc has burned away so far that the clutch has been lowered to the point where it begins to relax its grip, and now feeding commences, the rod slipping a little, but the clutch simultaneously rises a little, and grips again, again to descend. In a well-adjusted clutch lamp the clutch is indeed incessantly rising and falling through minute distances about the critical position. A bad clutch, or one that is deranged by dirt, will overfeed, and then rise too far, feeding spasmodically. Theoretically, all these clutches possess the retractile property so useful in keeping a steady arc when the carbons are of indifferent quality. But it is obvious that their perfection of action is impaired by dirt, dust, and inequalities in the surface of the carbon-rod due to wear and tear.

Clutches of the class termed "forward-feeding" belong to a different category, as they have, for the most part, no retractile power. In Newton's form [1,623, 1883] a piece of steel curry-comb, bent so as to form a sort of lobster-trap, encircles the carbon-rod, and forces it gradually forward when mechanical vibrations are imparted to it by a lever, working with a vibration on the plan of the well-known electric-bell vibrator, from the armature of a shunt-magnet. The latest variety of this species of forward-feed is that of Holmes [769, 1886], shown in fig. 15. Here, a shunt electro-magnet, S, attracts an armature, *a*; the latter being mounted upon a vertical lever. The carbon-rod, CC_1, is gripped between two blocks which are pressed against its sides by two curved springs, s_1 and s_2. The armature lever is attached to s_1, and is connected across by a small rod, *p*, to the spring s_2. When the armature, *a*, is alternately vibrated backward and forward by the magnet, the gripping blocks propel the carbon downwards. The make-and-break device which turns the current off and on in the magnet coils, is not shown in the cut. It consists of an ingenious modification of Holmes's snap-switch.

(*To be continued.*)

ELECTRIC LIGHT STATIONS AS FIRE RISKS.*

By S. E. BARTON.

IN the latter part of last year I was informed by your secretary Dr. Garratt, that at this convention "the subject of insurance in relation to electrically-illuminated buildings, and also the question of electric light stations as fire risks," would receive attention, and I was asked by him to prepare a short paper on one of these subjects. I wish first to acknowledge the honour I feel in being invited to speak before so scientific and large an assembly as this Convention of the National Electric Light Association. Through stress of circumstances my paper will be short, but I wish to touch both subjects in a general way. Insurance companies, like yourselves, sometimes get involved in litigation, and it is my unhappy lot to have been drawn into that unfortunate condition, to the exclusion of almost everything else, for the past two months. I offer this information as a preliminary apology for what may follow. Perhaps my misfortune in being caught in the toils of the law may prove to be your good fortune, because I am full to overflowing on the subject before me.

I cannot refrain, in the outset, from congratulating myself, and my insurance associates in New England, upon the very cordial relations existing between ourselves and the electric lighting interests, and also upon the very favourable experience the underwriters of New England have met with in having comparatively little loss to pay on account of the electric lighting fire hazard. Nor can I refrain from saying that, as favourable as our experience has been in the past, it is being, and will continue to be, made much more favourable through the good work undertaken and being carried on through the New England Electric Exchange. Its influence and results tend in the right direction—to the education of those employed in the electric lighting pursuits as to what practices and work are safe and what are not, and to the exclusion from such pursuits of any who may, through lack of proper scientific knowledge, be unqualified for the positions they hold.

As a matter of fact, however, I believe that the experience has been, that because men have been required to provide themselves with a licence certificate as to their qualification, they have speedily and earnestly set themselves to work to gaining the necessary technical knowledge to qualify them to receive the certificate. It goes without saying, I think, that those men are thereafter more capable in their business, and safer men for all parties concerned than they were before.

At the risk of giving voice to trite expressions, I am going to reassert that I believe we are all agreed that there is no element or force with which we deal that is more capable of self-control than the one which called into existence this association, nor is there one prolific of danger or hazard in more ways when unscientifically and carelessly handled.

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* Paper read at the Convention of the National Electric Light Association at Chicago.

Now, then, having on the one hand an element so fraught with hazard, and on the other one so easy of control, your duty is obviously to do all you can by your own work to promote and secure safety, and to encourage all feasible plans and efforts of others tending in the same direction. While the plain duty of underwriters in the public interest is first to hold to a strict line of requirements any of you who may be tempted or compelled, through competitive pressure, to depart from what you know are safe practices; and having done that, the underwriters' duty is not fulfilled until they have endorsed electrical illumination and power by the reduced premium charges that such combined action on the part of electrical and insurance interests is sure to warrant. The two interests are peculiarly identical. Hand in hand they can accomplish much in reducing the enormous fire waste. Disunited and antagonistic to each other, your work will be slower in development. Competition among yourselves, and no restraining supervision on our part, will drive you to cheaper construction and maintenance of your work. More fire loss and higher premiums for insurance must inevitably be the result, while the public, still calling for your light because it is good, will be deterred to an injurious degree by reason of the increased insurance rates that will surely follow, such as have already been applied in some cases and threatened in others.

The policy of insurance companies and organisations toward electric lighting—or any hazard, in fact, capable of being minimised—should not be "to fit the punishment to the crime," but rather to lessen the crime, or endeavour to. In your case they will be loth to undertake that policy without your co-operation, and can succeed only with it. Without their co-operation I think you would make but little headway in that direction.

In New England electric lighting is very popular with insurance men, particularly since it has, as applied to some risks, been included in the schedule of "improvements" for which a reduction in tariff is made. The energetic agent in his efforts to scoop in his competitors' pet risks does not fail to recommend the introduction of electric light as a means of procuring a lower rate and securing the risk to himself. He thereby becomes your solicitor. He goes still further: in many cases he manifests his favour to you and serves his own interests by becoming an investor in your apparatus and a promotor of your industry. Such a condition of things is but the natural outgrowth of a perfect harmony and co-operation between the two great interests. It ought to exist throughout the land.

By reason of faulty work which crept in during the early stages of electric lighting in Boston, numerous small fires which have occurred there have created a scare among insurance men, causing a threatened increase in rates unless a remedy was applied. The following notice, just issued by the Boston Board of Underwriters, indicates where they look to for relief:—"At a meeting of the Underwriters' Committee, held January 28th, 1889, it was voted that on and after May 1st, 1889, all electric lighting and wiring companies' men, who are in any way responsible for any of the wiring, running of dynamos, or care and management of batteries for electric lighting, must hold a licence from the New England Electric Exchange. This rule applies to isolated plants and central stations alike, and is imperative. No exception to it will be made." Such a rule may seem arbitrary to any one not in sympathy with the objects sought by the "Exchange" (and there will always be found some objectors to any good movement), but, after all, I believe it is just the medicine needed for the complaint.

In regard to the electric light generating station, the situation is not a pleasing one to either party. Out of over 200 fire insurance companies doing business in Massachusetts, the electric light station is a prohibited risk with all but about 25 or 30 of them. The reasons for this interdiction are chiefly these: First, because electrical apparatus, and dynamos in particular, have been found to be very susceptible to large and uncertain damage in cases of small fires; secondly, because generating stations have too frequently been crowded into very hazardous and improper quarters, simply to get floor space and power at the smallest cost, without regard to permanency and ultimate results; lastly and mainly, because insurance men, as a rule, do not understand the nature of the hazard and often fail to get enlightenment from those in charge of stations. Therefore a large majority of the companies adopt the course of all wise underwriters—they "take the benefit of the doubt" and leave your station risks alone.

Judging from my own observations of the way in which electric light station risks are peddled about to find takers, and the rates that are charged by reason of their being so few takers, I am led to believe that the question of insurance is to many of you an unsatisfactory one. I cannot help thinking that, even with the present condition of stations as fire risks, if the business as a whole were so classified as to show the aggregate premiums on the one side, ond the losses and expenses of doing the business on the other, a fair margin of profit would be shown. But no such general classification or account is made, and the experience of those few companies that venture on your risks, if favourable, is carefully kept to themselves, so that others may not be induced to venture.

Perhaps a bureau of the National Electric Light Association might be formed, the purposes of which would be to collect information as to the aggregate premiums paid and losses incurred in central station insurance. If such a labour should demonstrate that a fair profit remained after deducting gross losses and expenses from gross premiums, probably modified rates and a freer acceptance of the risks would follow. If it demonstrated that the present high rates of premium yielded no profit to those companies insuring your plants, then you would be convinced of something radically wrong, and you would have before you a field for investigation and a work of much needed reformation.

May be, an Electric Light Mutual Fire Insurance Association would solve the question; but such a step should be taken with caution, and should be guided by those well founded principles and practices that have proved so successful with the Manufacturers' Mutual Fire Insurance companies of New England, and of which Mr. C. J. H. Woodbury (well known to many of you) is a prominent officer. No risk should be accepted by such an association until improved to a certain standard as a fire risk, and then regular quarterly or tri-yearly inspections should be made, to see that the standard of equipment and care in operation were maintained. Much valuable information as to improved modes of construction and equipment could be disseminated by such an association, or even by your own association.

In some such general way as I have suggested, the question of central station insurance can be settled, but while the present tendency to temporary or makeshift installation shall continue, the question will hardly reach a satisfactory solution. Surely the capital invested in generating plants would seem to warrant some general action looking to the standardising and maintainence of them, and their insurance at a moderate cost.

WORK ON INDIAN TELEGRAPHS.

THE Administration Report of the Indian Telegraph Department for the year 1887—88 has just been issued. The most important event was the transfer on 15th February, 1888, of the Indo-European Telegraph to the Indian authorities, but no report on the change is yet available. Regarding the Indian lines we learn:—

"The total capital expenditure to the end of the year is Rs. 4,27,77,583. The revenue of the year amounts to Rs. 66,28,660, and the expenditure was Rs. 42,92,248, leaving a surplus of Rs. 23,36,412, which is equal to 5·46 per cent. on the capital. Omitting the *pro formâ* revenue, and the value of the messages despatched on the service of Government, the surplus is reduced to Rs. 5,94,234, and the interest on capital to 1·39.

"2,807,617 paid telegrams were despatched against 2,516,826 in 1886—87, an increase of 290,791; of which increase, 206,487 were private and 84,304 State. A considerable amount of the increased traffic of late years is due to the large number of branch telegraph lines and offices which have been established. These feeders all bring work on to the main line wires which are now taxed nearly to their full capacity; and a considerable increase to the trunk wires will shortly be inevitable to enable the growing traffic to be satisfactorily dealt with.

"The message revenue amounted to Rs. 51,73,045 (including Rs. 5,049 credited to Provincial offices), showing an increase over 1886—87 of Rs. 3,42,806; of which Rs. 10,945 was for State, and Rs. 3,31,861 for private telegrams.

"190 new offices were opened during the year, raising the number open to the public on the 31st March, 1888, to 2,579. Of these, 745 were departmental and combined offices, and the remainder licensed offices on railways and canals. The total number of public telegraph offices has increased 61 per cent. during the past five years (since 1882–83), and the increase in the same period in departmental offices has been 431, or 137 per cent."

The capital expenditure of the year was chiefly on new lines and wires, 5,014 miles of wire and cable having been laid. The increase in receipts during the past four years has been enormous. It was only about 41 lakhs in 1883, and it is now over 66 lakhs. The net revenue in the same period has risen from 3¼ lakhs to over 23 lakhs. This is mainly due to the small increase in working expenses, which have only risen 5¼ lakhs, while the receipts have increased by 25 lakhs. Inland State telegrams continued to rise above even the unprecedented figures of 1886–87, but Upper Burma was responsible for this. Foreign State telegrams were fewer in number and less in value. The inland private traffic is thus described:—

"This class of telegrams increased 10·49 per cent. in number, and 9·02 per cent. in value over the figures of 1886–87.

"As was the case in the year 1886–87, nearly one-third of the increase, both in number and value, was collected in Upper Burma alone, and was to a great extent due to the special circumstances of a large number of native troops serving in that province at a distance from their families. The remainder of the increase was very generally distributed, the Sind and Baluchistan division being the only one that showed a decrease, due apparently to the contraction of operations on the frontier railways. More than one-quarter of the increased receipts, or Rs. 43,609, were collected in new offices, opened at the close of 1886–87 and during 1887–88. As the return traffic addressed to these new offices, and practically created by them in the old offices, must also have been very considerable, it is evident that but for these new offices, and for the exceptional traffic from Upper Burma, the ordinary increase of traffic in the older offices throughout the country generally would have been very small, thus indicating that the use of the telegraph by the public continues very stationary, except when developed by an expenditure of capital on extensions of lines and offices.

"The average length of an inland private telegram in all classes remains remarkably constant at a little over ten chargeable words, exclusive of the free address, which is often, especially in the case of messages to natives, very voluminous. The concession of a free address is one that has been withdrawn of recent years in the United Kingdom, and the general principle adopted there, and in Europe generally, is that senders should be charged for the work their telegrams involve, as measured by the number of words. This rule was formerly in force in India, but was abandoned in 1873 in favour of a free address in deference to public requirements, experience having shown, not only the difficulty of delivering telegrams insufficiently addressed in a country where there is so much similarity in names, but also the unwillingness of senders to give adequate addresses when it was necessary to pay for every word. In any comparison of the Indian tariff with those of other countries, it is therefore necessary to allow for the mass of matter which we carry free in the address, the latter being often very much longer than the body of the message itself, which alone is charged for."

As regards foreign private telegrams, traffic between India and Europe was almost stationary, but there was an improvement in other directions. There was some growth in foreign press telegrams, though only 723 were sent. The telegraphic money-order system is expanding, owing to the simplification of the rules. The speed with which messages are sent has been greatly accelerated. The extension of the Indian wires to Upper Burmah, *via* Manipur, has been a work of considerable difficulty, the staff employed suffering much from hardships and exposure, but the line has been permanently laid. As to the prospect of an overland line to China, it is stated:—

"The opening up of telegraphic communication in China made rapid strides during the year. The northern line from Shanghai, *via* the provinces of Hupe and Szechuen, was completed to Yunnan, and three offices have been opened in that province, which is partly co-terminous with the British frontier in Upper Burma. A second line from Yunnan to the Coast ports, *via* the provinces of Kwangsi and Kwantung to Canton, was also under construction, and from recent official reports this line was expected to have been completed to Yunnan in March last, thus affording two routes from Yunnan to the Pacific Ocean. These extensions are a matter of considerable interest to India, as there now remains but a short link to connect the wires of this department and those of the Chinese Government in the neighbourhood of Bhamo. When this has been done, a comparatively cheap telegraphic tariff between India and China will, with the co-operation of the Chinese Government, probably be possible. The latest information received regarding the progress of the telegraph line in Western Yunnan was that it had reached Momein, which is about 140 miles from Bhamo."

In the matter of improved appliances the report states:—

"The trial of hard drawn copper wire, mentioned in last year's report, having proved encouraging, a wire of this metal was put up between Bombay and Madras, 800 miles, and between Bombay and Nagpur, 520 miles. It is in contemplation to extend this latter, by wire of a similar metal, to Calcutta, as soon as the line of posts along the Bengal-Nagpur Railway is completed. The results obtained on the new wire are highly satisfactory. Bombay and Madras are now able to work quadruplex without any intermediate translating station. The difficulties connected with the manipulation and erection of the "hard drawn copper wire" have in practice proved, with ordinary precautions, to be less than was anticipated. The use of this wire would have been much extended had it not been for an exceptional rise in the price of copper, which has rendered the purchase of it for the present almost prohibitive. It is, however, in contemplation to attempt its manufacture in the Telegraph Workshops in Calcutta, utilising old cable core and copper in stock.

"Quadruplex working was introduced during the year on the line between Calcutta and Rangoon, a distance of over 1,000 miles, with Akyab as a half-way station, where the signals are automatically repeated. The introduction of the same system was also arranged for on one of the wires between Calcutta and Agra, with Allahabad as the repetition station. The number of circuits worked duplex has also increased, and there are now 28 main circuits, most of them of great length, worked on the quadruplex or duplex system. The suspension of the copper wire between Madras and Bombay, which was completed early in the year 1888, has very much improved quadruplex working between those cities; and the important Australian and China traffic which mainly traverses India by this route is disposed of with great ease and rapidity."

Correspondence.—Two letters have just reached us, one from Captain Trott on a similar subject to that which we publish from the pen of Judge Weatherbe, and another with the *nom de plume* of "A Student," asking some questions respecting the recent paper of Prof. Jamieson on the designing of dynamos. If this latter gentleman sends his name and address, we will endeavour to satisfy his desires in our next issue, in which Captain Trott's communication will also appear.

NOTES.

Opening of the Paris Exhibition.—M. Alphand has formed a very curious project for the grand *fête* which will be given in Paris on May 6th to celebrate the opening of the Exhibition. In the evening general illuminations will unite the woods of Boulogne and of Vincennes by an uninterrupted cordon of fire. The electric light, gas, and coloured lamps will be employed in this colossal illumination, which will comprise the Avenue du Bois, the Champs Elysées, the Place de la Concorde, the Rue de Rivoli, the Rue St. Antoine, the Bastille, the Faubourg St. Antoine, the Place du Trône, the Courts of Vincennes, and the Avenue Dumesmil.

Wharf Lighting.—The incandescent system of electric lighting has just been applied to the Dundee, Perth, and London Shipping Company's wharf at Wapping. The landing stage and approaches are lighted by three and four light clusters, which give a brilliant light all over the wharf. In the offices, waiting-rooms, and throughout the warehouses there are single 16 candle-power lamps fitted to suitable fixings to meet the requirements of each department. Steam is supplied from the boiler used for the cranes and hoists in the warehouse, which drives an engine of 12 horse-power. The dynamo is compound wound for self-regulating, and is capable of supplying 120 lamps. The installation has been fitted up by Messrs. Paterson & Cooper, of London and Glasgow.

Electric Lighting of Trains in Wales.—For the first time in Wales a train was lighted by electricity on Wednesday, the 13th inst. The train is one of the two that run regularly on the Penarth branch of the Taff Vale Railway. Fifty Swan-Edison lamps of 12 candle-power each were placed on the train. The electricity is generated by means of a dynamo fixed in the guard's van, and run from the axle by a belt. Till the train attains a speed of 10 miles an hour current is obtained from the accumulators (which are supplied by the Electrical Power Storage Company), but at and over that speed it is driven direct from the dynamo. The second train is now being fitted in the same manner, and there is every reason to believe that the directors will extend the system of electric lighting to the whole of their trains on the main line, and the Aberdare and Treherbert branches.

Electric Lighting in Galway.—The Galway Harbour Commissioners at their meeting last week decided by a majority of ten to five to adopt the electric light for harbour purposes, so that vessels discharging at the port can do so at night as well as day in future. The rate for lighting is £1 19s. 6d. per lamp per year. The Electric Light Company has received a large amount of orders from private consumers, and Galway expects to be one of the best lighted towns in Ireland. Public institutions and factories are very much in favour of the new luminant, although the town commissioners have decided by a majority to continue to light the town with gas. Mr. Perry, County Surveyor, who is one of the principals of the Electric Light Company, stated at the Harbour Board meeting that in a short time he would utilise the 50,000 horse-power that at present ran useless down the Galway River.

Chelsea and the Electric Light.—At the last meeting of the Chelsea vestry the electric lighting committee reported recommending that the vestry assent to a proposed extension of the area of supply by the Chelsea Electric Supply Company, Limited, comprising a district between a line formed by the northern boundary of the district comprised in schedule "A" to the Chelsea Electricity Lighting Order, 1886, and the western and northern and eastern bounderies of the parish of Chelsea (a map of the additional area being enclosed). Mr. Irons moved the adoption of the report, which was carried.

The Electric Lighting Acts.—The Board of Trade has appointed Major Marindin, C.M.G., R.E., to hold an enquiry with reference to the various applications for Provisional Orders and licences under the Electric Lighting Acts which they have received in respect of the metropolis. The enquiry will be held at 8, Richmond Terrace, Whitehall, and will commence at 10.30 on Wednesday, April 3rd.

Cost of Electric Lighting.—From the reports of the various electric lighting systems in operation in the United States, we gather the following information as to the number of lights and their cost in a few of the principal installations:—

Town.	No. of Lamps.	Average cost of Lighting per Night.	
		s.	d.
New York	1,435	1	5¼
Philadelphia	756	2	1
Brooklyn	1,014	1	10¼
Boston	695	2	8¼
New Orleans	822	1	5
Baltimore	577	2	1
Buffalo	996	1	10¼

Promotion in the Indian Telegraph Service.—The Indian Telegraph Department is still suffering from a block in promotion, states the *Pioneer Mail*, and the unfortunate officers most concerned have now yet a further grievance which, so far as we can judge, seems to be a perfectly just one. The Director of the Department, Sir Albert Cappell, was granted an extension of his term of office last year, as he had not attained the age of 55 years, and he is now at home on furlough with no intention of returning to this country. In fact, as appears from the last half-yearly report of the Eastern Telegraph Company, he accepted some time ago the post of a director of that company in succession to Lord Alfred Paget, who died last August. He has, however, not resigned his Indian post, and no flow of promotion can take place until he does so. The case really stands thus. The pay of the appointment of Director-General of Indian Telegraphs is Rs. 3,000 per month; that of the office of Director of the Indo-European line was formerly £1,800 per annum. Colonel Mallock is now controlling the amalgamated lines as Officiating Director-General on Rs. 2,600 per month only, the reduction in pay being, of course, due to the absence of the permanent incumbent of the appointment, Sir Albert Cappell, on £800 a year furlough pay. Not only is the work of the Director-General in India enormously increased by the absorption of the Indo-European line, without the least increase in the staff, but a number of other officers have to share the burden at the same time that their salaries are adversely affected by their appointments remaining officiating instead of permanent ones. The want of promotion in the Telegraph Department has long been acknowledged by the Government of India, and it seems anomalous, to say the least, that the block should be aggravated by the retention in the service of an officer who has practically severed his connection with the Department, and who is holding a lucrative appointment in London.

The French Antilles Cables.—These cables, which connect Cuba, Hayti, Santo Domingo, Curaçao, and Venezuela, and which were laid some months ago by the ss. *Roddam*, were opened to international telegraph service on the 7th of February last. Telegrams destined to the places touched at by these cables, in addition to the mention of the ordinary route, should be directed "*viâ* Hayti."

Cable Ship Intelligence.—We learn that the *Scotia*, with a portion of the cable for the completion of the West African telegraph system to the Cape, left St. Vincent on March 16th. The *Silvertown* left Teneriffe on the same day, having on board the remainder of the cable required in the above-named system, in addition to the cable for the Bonny-Principe section. It is reported that the *Faraday* has completed the duplicate line in the Gulf of Mexico between Galveston and Goatzocoalcos.

Recent Interruptions and Repairs to Land Lines and Submarine Cables:—

Line.	Interrupted.	Repaired.
Land line, Transandine ...	19th Jan., 1889 ...	31st Jan., 1889.
„ Saigon-Bangkok	26th Jan., „ ...	29th „ „
„ Indo-European „ Kertsch - Soukhoum Kalé ...	19th Feb., „	Still interrupted.
„ Puerto Plata-San Domingo ...	22nd Feb., „ ...	24th Feb., 1889.
Cable, Bahia-Rio Janeiro ...	30th Jan., „ ...	5th Feb., „
„ Trinidad-Demerara ...	3rd Feb., „ ...	9th Feb., „
„ Punta Rassa-Key West	29th Jan., „ ...	12th Feb. „
„ Constantinople-Odessa	12th Jan., „ ...	13th Feb., „

Electric Cable in the Clyde.—A letter has been written by Lieutenant Davis, of Fort Matilda, to the Clyde Lighthouse Trustees asking if the Trustees had any objection to a tentative electric cable being laid in the river from Fort Matilda, for the purpose of testing whether the cable could be laid out in that way without detriment, and stating that, for the purpose of taking occasional electrical tests, a "dormant" buoy was proposed to be attached to the end of the cable. The clerk has informed Lieutenant Davis that the Trustees would have no objection to the proposed cable, on the understanding that it would be in no way prejudicial to the navigation.

The Channel Cables.—A news agency states that the representatives of the French and Belgian Telegraphs Department who were deputed by their respective Governments to discuss with the English officials the terms upon which the submarine cables between England and those countries should be taken over, have arrived at an agreement as to the price which shall be offered for the cables and plant. This was promptly communicated to the British Treasury, where the agreement arrived at was definitely approved, and an offer was immediately afterwards made to the Submarine Telegraph Company on behalf of the countries interested. The price which the three countries have agreed to pay is not so large as the directors of the Submarine Telegraph Company expected, but, on the other hand, it is far from being a confiscation price, which many of the shareholders anticipated. The amount will be announced in Parliament within a few days, immediately after the French and Belgian Governments have ratified the decision arrived at by their representatives. There is now not the slightest doubt that this will be done, and that the General Post Office will be in a position to take over the working of the submarine cables on the 1st of April. The officials of the English Post Office are to be congratulated upon the skill which they have displayed in bringing this most difficult business to a successful issue.

A Telegraph Ministry for Italy.—The formation of a Ministry of Posts and Telegraphs for the kingdom of Italy has just been definitely decided upon by a council of Ministers. The King has signed the decree.

The Post Office Telegraph Service.—There was issued with recent Parliamentary papers an estimate of the additional amount required in the year ending March 31st, 1890, to defray the salaries and working expenses of the Post Office telegraph service, in consequence of new arrangements for working the submarine telegraph cables between England and Belgium, France, Germany, and Holland. The gross total of the estimate is placed at £60,050, against which there is to be set off the sum of £10,150, constituted by receipts from the telegraph administrations of the aforesaid Continental countries for one half the cost of maintaining the cables. The net total is, therefore, £49,900. Estimates for revenue departments for 1889–90 have also been issued. There is a decrease in the estimate for Customs of £14,920, for Inland Revenue of £50,668, for Post Office of £215,913; an increase for Post Office Packet Service of £21,205, and for Post Office telegraphs of £48,780, being a net decrease on the five branches of £211,516.

Royal Society.—At the meeting of Thursday the following papers were to have been read :—By S. Bidwell, F.R.S., "On an Effect of Light upon the Magnetisation of Iron ;" and by Dr. J. Hopkinson, F.R.S., (1) "Recalescence of Iron" (2) "Electrical Resistance of Iron at a High Temperature."

Rental of Telegraphic and Telephonic Lines in Paris.—A decree has just been published as to the annual rent which the city of Paris is authorised to collect for the establishment of telegraphic and telephonic lines, which is fixed for each double conductor at 1 franc per 100 metres. This rate is reduced one-half for single conductors. This rent is calculated according to the real length of the double or single conductor by an indivisible fraction of 100 metres. The lines used exclusively as fire warnings and connecting private establishments to the Municipal establishment, in case of fire, are only chargeable 1 franc for each conductor leading to these warning instruments.

Removal.—The engineer's office of the Metropolitan Electric Supply Company has been removed from 5, Whitehall Yard, to 4, Waterloo Place, S.W.

The Thomson-Houston System.—We are informed by Messrs. Laing, Wharton and Down that that portion of their business relating to the Thomson-Houston system of electric lighting has now been formed into a limited company, under the title of the "Laing, Wharton and Down Construction Syndicate, Limited," with a capital of £40,000. None of the shares will, however, be offered to the public, as the whole of the issue, viz., £30,000, has been privately subscribed.

Presentation.—The Grand Medal offered by the Society for the Encouragement of National Industries has been presented to M. Emile Baudot, telegraph engineer. This medal is offered by the Society every year to the person, French or foreign, whose work during the preceding six years is considered to have exerted the greatest influence over the development of French industries.

General Electric Company.—Messrs. G. Binswanger & Co. have just issued the 7th edition of their catalogue of electric bells, telephones, and medical apparatus. This catalogue is in addition to their electric lighting catalogue, which was referred to in our columns a few months back. These lists taken together give very complete descriptions, as well as prices, of almost every article of applied electrical manufactures. The electric bell catalogue has been much increased in size, and now contains more than 260 illustrations of electric bells, indicators, pushes, batteries, alarms, galvanometers, lightning conductors, telephone and telegraphic instruments, and electro-medical apparatus. We have no doubt this catalogue will facilitate the purchase of electrical goods in England and the colonies, and would recommend our readers to apply for a copy.

Increased Business.—Owing to increase in business Messrs. E. Wiggins & Sons, of 10, Tower Hill, have taken additional premises at 102, Minories, the two establishments being in telephonic connection.

Storage Batteries in Cars.—Mr. John A. Brill, a Philadelphia car builder, proposes to alter the usual method of placing storage batteries in position underneath the seats of cars. At present, in the States, the side panels of the cars are loosely hinged to the car body, so as to be removable ; but in this arrangement the braces are cut away or dispensed with, and the car is weakened in the parts requiring greatest strength. Mr. Brill's method is to bring the batteries up on trucks on a level and in a line with the position which they are to occupy, open doors in the dashboard and at the end of the car, and run the batteries straight in underneath the seats, rollers in the flooring facilitating this process.

Café Monico.—This well-known restaurant, which has just been very much enlarged and beautified, is lighted throughout by electricity, the dynamos in use being one Phœnix and one Castle. For the new portion of the building a distinct installation has been carried out in a very substantial and effective way by Mr. A. Koerber, of Frith Street, Soho. The cables and wires are all of Henley's best make, the switch boards by Woodhouse and Rawson, and the fittings by Taylor and Tucker. Altogether the addition consists of about 200 lamps, 3 being Sunbeams of 400 C.P., 12 Sunbeams of 200 C.P., and the rest 16 C.P. lamps, mostly arranged in groups under reflectors.

Chinese Telegraphs.—Says the *Pioneer Mail* for February 13th :—We have from time to time noted the rapid extension of the Chinese telegraph lines westward towards the frontier of Upper Burmah, and it is satisfactory to see from the annual report of the Indian Telegraph Department that only a short link is now missing in the chain of overland communication. On this side Bhamo is connected by wire with Mandalay, which is again in touch with Calcutta by the Chindwin and Manipur lines. On the Yunnan side the Chinese line turns from Shanghai through the provinces of Hupé, Szechuen, and Yunnan. There are three offices open in the last-named province, the present terminus being at Momein, distant only some 140 miles from Bhamo. The Indian authorities could at once extend their wire to the frontier, some 30 or 40 miles east of Bhamo ; and it therefore needs no great effort of co-operation on the part of China to make the through line an accomplished fact. This would give cheaper and more direct communication with Pekin and the eastern seaports on the China coast, and relieve the pressure on the Madras-Penang cable, over which there is a very heavy traffic. The Chinese Government have already shown so much enterprise in building their line to Western Yunnan that they are not likely to hesitate now to put up another 100 miles of wire. In a year or two it is likely that Chittagong will be connected direct with Mandalay by way of the Lushai country, and thus the distance between India and China will be still further shortened. In any case we may hope to see within a short time an uninterrupted line of posts and wires stretching right across Asia from the Bosphorus to the Yellow Sea.

The Price of Copper.—According to the *Financial News*, at least one transaction in copper took place last week at £35 per ton, the lowest price that copper has ever touched in history.

Lecture.—Mr. A. R. Bennett, M.I.E.E., general manager of the National Telephone Company, delivered a lecture, a day or so ago, before the East of Scotland Engineering Association, on "Electric Traction." The lecture was mainly historical and descriptive ; it was heard with interest, and appreciatively discussed.

Kensington and the Electric Light.—Last Thursday evening, at the adjourned meeting of the Kensington Vestry, Mr. Herbert Saunders, Q.C., moved : "That the Vestry give their consent to an application to the Board of Trade for a licence to the House-to-House Electric Lighting Company, for the area bounded on the south and west by the parish boundary, and on the north and east from the point where the Kensington Road crosses the boundary, by the Kensington Road to the corner of Earl's Court Road, and from there by the Earl's Court Road to the Cromwell Road, and from there along the Cromwell Road to the Gloucester Road, and down the Gloucester Road and Cranley Gardens to the south boundary of the parish." Mr. John Braye seconded the resolution, which was agreed to.

New Journal.—The first issue of the new journal issued by the enterprising firm of Cassell & Co., *Work*, is of a very promising character, and we anticipate a large circulation for it.

Electrical Utilisation of Niagara.—A great deal has been said at different times about utilising the enormous power exerted by the Niagara Falls, and a definite scheme has now been plotted out by Mr. Silas Haines Hamilton, of Washington, D.C., for employing the falling water as the motive power for driving dynamos for light and power purposes. Mr. Hamilton seeks to avoid the construction of long tunnels, which others have suggested, and mollifies the æsthetic to some extent by proposing to hide his machinery behind the falls so as not to spoil the view. His plan is to get in behind the big, plunging body of water and there erect vertical pipes or flumes that shall catch a large portion of the water on the inner side of each fall, conveying it downward to ordinary "double discharge" turbines directly connected with lines of shafting in chambers excavated under the falls. This shafting is to drive dynamos of various types, according to the class of service to be rendered.

Street Railway Motive Power.—One of the obvious suggestions in connection with the recent great strike of street railway men in New York and Brooklyn, says the *Electrical World*, is that it must have involved an enormous outlay on the part of the companies for motive power that they could not use. In other words, for several days they had to feed their horses without any prospect whatever of getting any return for the expenditure. New York City has 13,458 horses engaged in street car traffic, and it is not an exaggeration to say that for nearly a week 10,000 of those horses were doing nothing but eat and sleep. It is at such times as these, or during some plague in the stables, that the advantages of electricity become most clearly visible. Should any unfortunate misunderstanding or rupture or strike occur, an electric plant can at once be shut down until brighter times come round again, and even then only so many tons or hundredweight of coal are required as will run the exact number of cars put in operation, and no more.

Electric Light and Gas in the House of Commons.—It appears that the addition of the electric light to the arrangements of the House of Commons, says the *Daily News*, has by some unaccountable process increased rather than decreased the expenses for gas. Last year the gas bill was £3,300, whilst the cost of the supply for the coming year is estimated at £4,000. This is in addition to an increase in the expenditure on electricity of £40. The supply of oil lamps in the Houses of Parliament still maintains its immense proportions. This year, as last, not less that £2,000 is paid for oil for the lamps, which are used only in the committee rooms, some of the lobbies, one of the reporters' rooms, in the ventilation department, and in the residences of officials. The total cost for warming, ventilating, and lighting the Houses of Parliament in the coming year is estimated at £16,100, against £14,520 last year.

Electric Traction.—Mr. W. W. Duncan shows much foresight in taking up the question of the introduction of electric traction upon tramways, says the *Financial News*. Tramways in England have not been doing so well as they ought in recent years, and directors should be ready to listen to any proposition likely to restore them to a better position as investments. Mr. Duncan gives, in his March circular, the results of personal observation of the successful working of electric traction on the Blackpool Tramway. It has been employed continuously for three years over a system two miles long. Mr. Duncan considers that these results point to the propriety of introducing electricity upon larger systems, and he promises to find capitalists who will install electrical power over two miles of the Liverpool tramways at their own expense, agreeing to restore the line to its former condition if the Corporation decides unfavourably on the change. This is a fair offer, and with the figures which Mr. Duncan produces it will be strange if the company and the Corporation do not accept it. Tramway shareholders everywhere will await the result with interest.

Electric Lighting in Brussels.—It appears that, contrary to their first intentions, the Brussels municipality will not exploit the electric lighting of the centre of the town themselves, but will invite tenders for the undertaking. *Industries* states that an electric light installation has been fitted up at the United collieries. There are employed at the Valée pits 7 arc lamps on iron masts and 50 glow lamps; at the St. Bernard pits there are 3 arc lamps and 30 glow lamps; and at the Feignat pits there is 1 arc lamp and several glow lamps. In the electric machinery hall 1 arc lamp and 5 glow lamps are employed, and there are also 20 glow lamps in the manager's house. Current is supplied from a Dulait dynamo of 350 ampères and 110 volts, running at 500 revolutions per minute. The dynamo is driven by an 80 H.P. Zimmermann-Hanres steam engine. The workings lighted are from 700 feet to 1,000 feet distant from the central station. The installation has been carried out by the Société Electricité-Hydraulique, of Charleroi, the superintendence of the work having been entrusted to M. Pitot. The company was established in July, 1886, and this makes its two hundredth installation.

Measurement of "v."—The measurement of "*v*" by Sir William Thomson and Profs. Ayrton and Perry, communicated to the British Association at Bath, was too small (292) on account of the accidental omission of a correction regarding the effective area of the attractive disc in the absolute electrometer. When this correction is applied their result is brought up to 298, which exactly agrees with Profs. Ayrton and Perry's previous determination by another method, in Japan. Prof. J. J. Thomson's result is 296·3. It is understood that Rowland has found 299. The result of Sir William Thomson's latest observations, founded wholly on the comparison of electrometric and electro-magnetic determinations of potential in absolute measure, is 30·1 legal ohms, or 30·04 Rayleigh ohms. Assuming, as is now highly probable, that the Rayleigh ohm is considerably nearer than the legal ohm to the true ohm, the result for "*v*" is 300,400,000 metres per second. Sir William does not consider that this result can be trusted as demonstrating the truth within ½ per cent.—*Nature*.

Liverpool and the Electric Light.—On Tuesday, the first meeting of the sub-committee of the Liverpool Watch Committee on electric lighting was held in the municipal offices. The question of consenting to the application of the Liverpool Electric Supply Company for a Provisional Order came up for consideration, but nothing was decided on this point, the committee confining itself to going through the clauses of the city engineer's report on the matter.

Removal.—The offices, warehouse, and show-rooms of the General Electric Company have been removed from Great St. Thomas Apostle to 71, Queen Victoria Street, a large building four houses west of Mansion House Station. The removal, we understand, has been necessitated by the largely increased demand for electrical goods consequent on the extension of the company's works at Manchester, resulting in large orders for electrical fittings for both the home and foreign trade.

A Big Demand for Damages.—The case of William Jones against the Edison Electric Illuminating Company, of West Chester, has been placed on trial in Chester County Courts. The case arises from a boiler explosion at the company's station on December 16th, 1887, when five persons were killed and several badly injured. Among those killed was Mr. Jones's thirteen-year-old daughter, Hettie, and he now brings suit for $10,000 damages.

NEW COMPANY REGISTERED.

Laing, Wharton and Down Construction Syndicate, Limited.—Capital, £40,000 in £100 shares. Objects: To acquire certain apparatus, undertakings, and installations belonging to the business of Charles J. Wharton, F. J. Down, and A. F. Davies, trading as Laing, Wharton and Down at 82A, New Bond Street, in connection with the Thomson-Houston International Electric Company's system of electric arc and series lighting, and for central stations high tension alternating incandescent electric lighting. Signatories: P. G. B. Westmacott, C.E., Newcastle-on-Tyne, 20 shares; Lieut.-Col. B. H. Martindale, C.B., Bickley, Kent, 10 shares; J. Tennant, Gateshead, 5 shares; J. T. Merz, Newcastle, 4 shares; W. Crewdson, 60, Courtfield Gardens, S.W., 5 shares; E. Waterhouse, 44, Gresham Street, 3 shares; G. H. Norman, 5, Southwell Gardens, S.W., 5 shares. The vendors are appointed managers, and will be entitled to £500 per annum for office and clerical expenses, and also to 10 per cent. on the annual net profits, but such remuneration is not to exceed £2,000 per annum. Registered 18th inst. by H. F. Kite of 11, Queen Victoria Street, E.C.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

General Zinc Recovery and Lighting Company, Limited.—An agreement of 4th January cites that in the year 1884, the Standard Electric Light Power Company, Limited, was formed and registered with a capital of £300,000 to acquire the sole right to use and sell in all parts of Great Britain, other than Scotland, electric piles or batteries as patented by Felix de Lalande, No. 1,464, dated 27th March, 1882. The liquidator of the Standard Company has agreed to sell the said rights and interests to the present company for £1,200 cash for distribution amongst all the trade creditors of the Standard Company, and for liquidation and legal expenses, and in payment of moneys due to the Earl of Onslow and Messrs. Wark and Saltmarshe. It is also agreed that this company shall allot to each of the shareholders (other than Mr. H. A. Ferguson) who signify their willingness to accept the same, an equal number of fully paid deferred shares in the Zinc Company to their holding in the Standard Company. Messrs. R. H. Baillie, Thos. Rome and P. Saltmarshe have each agreed to accept 50 fully paid deferred shares in satisfaction of several debts of £500 respectively due to them. Mr. H. A. Ferguson has also agreed to accept 3,000 fully paid deferred shares in this company in satisfaction of his claims against the Standard Company.

Automatic Trading Company, Limited (Armstrong's adaption of electricity to automatic and other apparatus).—The statutory return of this company, made up to the 4th April, 1888, was filed on the 17th November, 1888. The nominal capital is £100,000 in £1 shares. 28,107 shares have been taken up, and of these 24,175 shares are considered as fully paid. Upon 3,932 shares the full amount has been called, the calls paid being £3,665 3s. 3d., and unpaid £266 16s. 9d. 18 shares have been forfeited, but no amount has been paid thereon. Registered office, 37, Walbrook.

Elieson Electric Company, Limited.—The annual return of this company, made up to the 29th December, was filed on the 19th January. The nominal capital is £600,000 in £5 shares. The number of shares that have been taken is 35,985, but 4,800 of these have been cancelled. The full amount has been called up, and the shares allotted are considered as fully paid. The registered office of the company has been removed to 4, Broad Street Buildings.

New Portable Electric Lamp and Power Syndicate Company, Limited.—An agreement of 1st inst. provides for the rescinding of the principal agreement of the company, and for the allotment to Mr. Benjamin Nicholson, of 57½, Coleman Street, 13 fully paid ordinary shares of £200 each, in consideration of services rendered to the company.

Automatic Electric Supply Company, Limited.—The statutory return of this company, made up to the 5th inst., was filed on the 11th inst. The nominal capital is £25,000 in £1 shares; 15,500 shares have been taken up, 15,000 being considered as fully paid. Upon the remaining 7 shares the full amount has been called and paid. Registered office, Suffolk House, Laurence Pountney Hill, E.C.

Clamond Lighting Agency, Limited.—An agreement of 22nd ult. provides for the purchase of the business of Richard Oakley of 14, High Holborn, ventilating engineer. The purchase consideration is 500 shares. Mr. Oakley is appointed manager for five years, and is to receive 50 per cent. on the declared profits of the company.

Western and Brazilian Telegraph Company, Limited.—An agreement of 18th April, 1888, between this company and the London Platino and Brazilian Telegraph Company, Limited, states that as the undertakings of the companies are closely allied, it has become desirable, so far as practicable without effecting an actual amalgamation, they should be brought under a common control with a common proprietory. With this object, it is proposed that shares in the Western Company should be offered to the members of the Platino Company in exchange for their holdings in the latter company, and that the directors and officers of the Platino Company resign their positions in favour of the Western Company's board and officials, and that compensation should be offered to them for their loss of office. Such allotments of shares are to be in the proportion of three shares of the nominal value of £15 each of the Western Company, credited as fully paid up for every five shares of £10 each fully paid in the Platino Company. In consideration of their retirement the sum of £6,000 cash is to be paid to the board of the Platino Company, and the sum of £2,000 is also to be divided amongst the secretary, traffic auditor, clerk to the secretary, and registrar and his clerk of the Platino Company.

An agreement of June 8th relates to the allotment of shares as provided in the agreement above mentioned, and states that the Western Company, in order to enable them to make such allotment, have increased their capital by the creation of 3,090 shares of £15 each.

Agreements of July 12th and October 11th relate to the allotment of shares as provided.

Agreements of January 3rd, 1889, January 23rd and 24th states that the periods limited by the first agreement having expired it would be inequitable to permit any further exchange of shares upon a footing of a participation in the profits of 1887; but certain allottees being desirous to make the exchange, the company will allot

150 Western shares for 250 Platino shares
24 " " 40 " "
30 " " 50 " "
36 " " 60 " "

London Platino-Brazilian Telegraph Company, Limited.—A notice has been filed with the documents of this company containing the special resolution passed at the extraordinary general meeting held on April 27th last, relating to the adoption of the provisional agreement dated April 18th, between the Western and Brazilian Telegraph Company, Limited, and this company. The agreement has not been registered. The resolution was filed on May 18th, 1888.

Priestman Brothers, Limited.—The registered office of this company is at the Holderness Foundry, Kingston-upon-Hull.

Nottingham Electric Light and Power Company, Limited.—The registered office of this company is situate at No. 22, Low Pavement, Nottingham.

CITY NOTES, REPORTS, MEETINGS, &c.

Western and Brazilian Telegraph Company, Limited.

AN extraordinary general meeting of the members of this company was held at Winchester House, Old Broad Street, on Tuesday last for the purpose of ratifying an agreement dated the 8th day of March, 1889, made between this company and the Brazilian Submarine Telegraph Company, Limited, with respect to the working of the lines of the two companies and the division of the traffic receipts thereof. Mr. W. S. Andrews occupied the chair.

The Secretary (Mr. J. M. Cunningham) having read the notice calling the meeting,

The Chairman said: This is a special meeting called for the special purpose of considering the agreement that has been made, subject to your sanction, between the Western Brasilian Telegraph Company and the Brasilian Submarine Telegraph Company. You are aware no doubt that an agreement has subsisted between these companies for many years, and that it is under that agreement that we have both of us been working our respective undertakings. The term of the agreement was approaching an end, and it was therefore thought by the boards of both companies that it would be a judicious course, and one in the best interests of the two associations practically to continue for a further period that agreement. This is what we have done. There is very little in the new agreement that differs materially from the old. He concluded by asking the company's solicitor (Mr. Bompas) to read the terms of the agreement.

The Solicitor having accordingly read the document,

The Chairman added that it would be seen that the agreement was pretty much on all fours with the arrangement subsisting between the two companies at the present time. There was one condition which was insisted upon by the Brazilian Submarine Telegraph Company—namely, the laying down by the Western and Brasilian Telegraph Company of loop lines on certain sections of the latter's system, the former's system having loop lines, or being duplicated, in fact, from end to end. They agreed to that because they thought that that measure would be as beneficial for the company as it would be for the joint undertakings. They would be assured against interruptions. They could therefore give continuous telegraphy, and another result would be that they would avert the losses which he might say had been sustained in the past. It was also decided that the arrangement between the two companies should be accompanied by a substantial reduction of rates in the public interest. Those rates had been advertised in the *Times*, and constituted a very considerable boon to the telegraphing public. He did not know whether he could say that that circumstance would ultimately prove to be so advantageous to the company as to those who sent telegrams, but they must hope for the best. Generally speaking, upon a reduction of the kind there was an increase in a greater or lesser degree of receipts. They did not as a rule get the same money back for some two, three, four, or five years, but still it began to return after that time, and no doubt in this particular case they must take time by the forelock and endeavour to meet the wishes of their clients in the telegraphing world. The percentages were pretty much on all fours, taking their proportion some time back and at the present time. There were penalties to be imposed in case of interruptions, but it was to be hoped that those penalties would never have to be enforced. He concluded by moving a resolution approving of the agreement submitted to the meeting.

Mr. Weaver seconded the motion.

A Shareholder asked what would be the amount of capital required for the proposed new sections to the cable, and how it was proposed to raise it.

The Chairman replied that the subject would come before another meeting. They did not wish to commit themselves to the price or the way in which they were going to pay for the cable. That would be all submitted to the ordinary general meeting which would take place early in May.

Mr. Dyatt asked whether they would issue the printed agreement among the members.

The Chairman said it was not usual to spread broadcast among shareholders agreements of such a character, and he did not think it would be a judicious thing to do so, but if any gentleman who wished to freshen up his memory as to any of the clauses would be good enough to call at the company's office he could be satisfied by having the agreement placed at his disposal. In further reply to another shareholder he said that they had been given to understand any time within the last five or six years or more that strong efforts were being made with the Brazilian Government for the obtaining of concessions which would enable lines to be operated in opposition to those of the companies now concerned, and no doubt to all of them it would be apparent that this was an additional reason why the lines should have been made as firm as possible. They had not been advised up the present that any recent concession had been granted. The concessions that had been given by the Government had not been brought into successful operation. Several, he believed, one after the other, had died out. He could not say what might happen in the future. All that they could do was to put their backs together and work in union. Like the bundle of sticks they would be stronger together than apart.

After a few remarks from Mr. Coppin, Mr. Guesdon, and others upon the necessity of affording the shareholders more information as to the agreement and the proposed new cable, as well as the method of raising the capital for laying it,

The Chairman said that the expediency of laying the new loop lines was brought before a meeting some 18 months' or two years previously. As to the amount of or the method of raising the capital, there were reasons, he repeated, why they thought it was better to defer their recommendations until the next meeting, and he hoped they would be enabled to submit to them such proposals as even his critical friend, Mr. Guesdon, would feel disposed to accept.

The resolution was then unanimously adopted.

Brazilian Submarine Telegraph Company, Limited.

AN extraordinary general meeting of this company was held at Winchester House, Old Broad Street, E.C., on Tuesday last, Viscount Monck presiding.

Mr. Richard Collett, the Secretary, having read the notice convening the meeting,

The Chairman said: Gentlemen,—I remember once, at a time of political crisis in the House of Commons, when considerable communication was going on between the heads of the different parties, Mr. Gladstone was subjected to a severe examination as to the state of affairs. He prefaced his answer by saying that he found it rather difficult to carry on delicate communications in a glass bee-hive. I sometimes think that the position of a director of a company is of the same character. The directors are constantly asked in meetings like this to give accounts with great minuteness of the manner in which their transactions are carried on. Now, though there may be nothing whatever that it is desirable to conceal on its own account, I put it to you as men of business, is there any private individual who can carry on his transactions under these conditions? No one likes to admit that he is losing by his business, and if you show great gains it might have the effect, particularly in a business like ours, of attracting competition which will very likely interfere with your future profits. We cannot communicate the nature of our transactions to you without, at the same time, taking the public into our confidence, and that, without our having anything to say which is in itself discreditable, may be very injurious to your affairs. Well, gentlemen, the only way in which I can conceive that that difficulty can be got over is by an extension of confidence on your part to your directors in the management of your concerns. My colleagues and myself have been now for something like 16 years engaged in the management of your affairs, and I venture to say that you will not disagree with the statement that our management of them has not been, on the whole, unsuccessful. I therefore ask you, in reference to this transaction, to accept the assurance of my colleagues and myself that the engagement we have entered into with the Western and Brasilian Telegraph Company is for the benefit of this concern. You are all aware that the Western and Brasilian Company was started at the same time as ours, and we have been from the beginning of our existence until now working in intimate relations with that company. You are aware perhaps, also, that our concession from the Brasilian Government, which gives us at present the monopoly of the traffic to Brazil, will terminate in four years from next June. The termination of that concession will not prevent our working to Brasil, but it will terminate our monopoly right of working to Brasil. Well, for some reason or other, the concession to the Western and Brazilian Company lasts for 40 years longer. I do not know how that occurred, but so it is, and the Western and Brasilian Company have a monopoly of their rights for 40 years longer than we have of ours. Hitherto we have worked with them by taking a certain proportion of their earnings, and giving them a certain proportion of ours; but we want now to make the connection more permanent and more intimate. Our future relations will be regulated by the receipts being paid into a joint purse, and each taking a certain proportion. The proportions are 54 to the Brazilian Company, and 46 to the Western and Brazilian. The agreement embodies several articles for giving thorough effect to that arrangement, and it contains one article to which I attribute great importance, and that is that enabling us to allow the Brasilian Government to come into the arrangement, if it should wish it, upon terms to be agreed upon. If that could be carried into effect, it would undoubtedly place both these companies in a very advantageous position. However, the Brazilian Government has not as yet shown much wish to give its adhesion to that article, and we must only hope that it will be better advised in the future. In the meantime it places our two companies on a very satisfactory basis for the future conduct of our trade. The Western and Brasilian Telegraph Company will, as hitherto, be collectors for us at the other end of the line, and will be bound to give us every message sent to them. We shall be acting in a similar way with regard to them, and we shall hand to them the messages which we receive for Brazil. I believe the advantage which we have hitherto derived from our connection with the Western and Brasilian Company will be increased by the arrangement we have now made. I will ask my friend Mr. Burt to read to you the agreement to which I have alluded, and I will then move that this meeting adopt it.

Mr. Burt, the solicitor, read the agreement, which consisted of nearly 20 articles, but the main effect of which was to secure the division of the joint purse in the proportions named by the chairman. An important stipulation was that the Western and Brasilian Company should lay down new lines extending on the one side from Pernambuco to Bahia and thence to Rio Janeiro, and on the other from Rio Grande do Sul to Monte Video; these lines are to be laid within two years of the date of the agreement, March 8th, 1889.

The Chairman moved, "That the agreement dated March 8th, 1889, and made between this company of the one part, and the Western and Brasilian Telegraph Company, Limited, of the other part, with respect to the working of the lines of the two companies and the division of the traffic receipts thereof, which agreement has been read at this meeting, be and the same is hereby ratified."

Sir James Anderson, in seconding the motion, said it had taken several years to bring the matter to that point, and he was sure they would do well to adopt it.

The motion was unanimously carried, and a vote of thanks to the chairman and directors concluded the proceedings.

The Western Counties and South Wales Telephone Company, Limited.

THE report of the directors for the year ending 31st December, 1888, states that the capital expenditure for the year ending the 31st December, 1888, has been £27,885 3s. 6d., making a total of £113,176 0s. 2d. to date.

The gross revenue of the company for the year 1888 was £32,306 9s. 7d., against £23,597 10s. 5d. for the year ending 31st December, 1887.

The amount of income carried forward to next year's revenue, as representing sums received in advance for periods extending beyond 31st December, 1888, is £10,403 7s. 1d., against £8,043 14s. 1d. in previous year's balance sheet.

The working expenses for the year 1888 have been £8,337 15s. 3d., against £6,693 8s. 3d. for the year ending 31st December, 1887.

	£	s.	d.
Balance of net revenue account	8,798	12	8
Dividend of 6 per cent. on the paid up preference share capital for the year ending 31st December, 1888	5,945	14	3
Balance for appropriation as per statement at end of accounts	£2,852	18	5

The directors recommend a dividend of half per cent. per annum on the ordinary share capital, amounting to £1,405 19s. 9d., and that the sum of £200 be placed to the special reserve fund, carrying forward £1,246 18s. 8d. to next year.

It will be seen from the following figures that the growth of the business of the company for the past year has been satisfactory; the number of subscribers to the company's exchange system having considerably increased, while there has also been a good addition to the number of private line renters. The subscribers to the various exchanges and the private line renters on the 31st December, 1888, and on the 31st December, 1887 (including orders on hand), were as follows:—

	Exchange.	Private.	Total.
December 31st, 1888 ...	2,054 ...	556 ...	2,610
December 31st, 1887 ...	1,572 ...	462 ...	2,034
Increase in 1888 ...	482	94	576

Mileage of trunk and renters' wires:—

Erected up to 31st December, 1888 ...	3,109 miles.
" " 31st December, 1887 ...	2,140 "
Increase in 1888	969 "

The company has increased its trunk system, so that on the 31st December, 1888, it had 283 miles of trunk pole lines connecting towns with each other, carrying 1,387 miles of wire; against 224 miles of pole lines, carrying 922 miles of wire, at the corresponding date in the previous year.

The company have received numerous enquiries for a connection between the principal towns of their district and the metropolis, and negotiations are pending with the United Telephone Company for the construction of the line.

It is also intended to connect Bournemouth, Southampton, and Portsmouth with London, *via* Winchester.

Enquiries have also been received for connection with these important places; and should circumstances warrant the expenditure, the company will proceed to make the necessary arrangements.

Numerous additional call rooms for the use of subscribers and the public have been opened during the year in the various towns, where, on payment of 2d., the company's local exchange subscribers may be spoken with; or, on payment of a small toll, any person can speak to any town connected by trunk lines. As an additional facility to the subscribers, it has just been decided to give them and their representatives the free use of all call rooms in their own town for local communication with other subscribers in that town.

The directors are pleased to state that the relations of the company with the Post Office officials continue to be satisfactory.

The Telephone Company of Egypt, Limited.

AT the sixth ordinary annual meeting of this company, held at the offices, 14, Austin Friars, E.C., on Tuesday, 12th inst., under the presidency of General Fraser, C.B., R.E., the following report of the directors was adopted:—

After writing off a sum of £227 8s. 7d. for depreciation, and providing for interest and expenses incurred in connection with the issue of debentures, the net profit for the year is £4,025 10s. 5d.; adding to this amount the sum of £665 2s. 6d. brought forward from 1887, the balance available for disposal is £4,690 12s. 11d. Out of this the directors recommend a dividend of 6 per cent. for the year on the preferred shares, free of income-tax, which will absorb £3,621 6s., leaving £1,069 14s. 11d. to be carried forward. The rearrangements for the management in Egypt, consequent on the death of the late manager, Mr. A. D. Evans, have proved satisfactory, and the directors were glad to have been enabled to entrust that office temporarily to his son, Mr. W. N. Evans, who has since been confirmed in the appointment. The loss of revenue during the year through the withdrawal of subscribers and other causes has been fully met by the continued growth of the exchanges, the total number of subscribers in Egypt on the 31st December being 980, against 917 the previous year. The extension from Cairo to Hélouan, mentioned in last report, has been established with satisfactory results. Efforts have been made to open a small exchange at Port Said, and it is hoped that during the current year the work may be carried out; at present, however, the support promised is not sufficient to warrant the commencement of the undertaking. The apparent increase of the working expenses is due to the fact that the whole of the wages and salaries of the permanent staff have during the past year been charged against revenue, the directors being anxious, so far as possible, not to increase the expenditure on capital account. In accordance with the notice in the last report the sanction of the shareholders was obtained to an issue of debentures not to exceed, in all, the sum of £20,000. Of this amount £5,000 were issued in Egypt, and the loan from the Oriental Company was paid off.

Monte Video Telephone Company, Limited.—This company announces an interim dividend at the rate of 6 per cent. to December 31st last on their preference shares, payable on and after the 23rd inst.

TRAFFIC RECEIPTS.

The Western and Brasilian Telegraph Company, Limited. The receipts for the week ending March 15th, 1889, after deducting the fifth of the gross receipts payable to the London Platino-Brasilian Telegraph Company, Limited, were £4,074.

The West India and Panama Telegraph Company, Limited. The estimated receipts for the half-month ended the 15th March are £3,690, as compared with £3,337 in the corresponding period of 1888.

REVIEWS.

Journal of the Institution of Electrical Engineers. No. 77, Vol. XVIII. London: E. and F. N. Spon, 125, Strand.

The chief contents of this number are as follows:—"Inaugural Address of the new President, Sir William Thomson: Ether, Electricity, and Ponderable Matter." "The Insulation Resistance of Electric Light Installations," by Prof. A. Jamieson. Abstracts, classified list of articles relating to electricity and magnetism appearing in English and Foreign journals.

Electricity in the Service of Man. From the German of Dr. A. R. VON URBANITZKY. Edited by R. Wormell, D.Sc. Part I. London: Cassell and Company.

The issue of this work will be completed in 14 parts (price 6d. each part). Although the original features of the work are to be preserved as far as possible, the publishers state that they have not hesitated to alter the same with great freedom where they are not in accord with English modes of thought and reasoning, and to add descriptions of apparatus made and used in this country, and matters generally interesting to English readers, not found in the German edition. The part commences with an excellent introduction by Prof. Perry. Following the general order of things, "Magnetism" is taken first, the subject being treated, especially as regards the last part, where "Intensity of Terrestrial Magnetism" is dealt with, with great clearness. "Static Electricity" is taken next, a notable feature being a dissertation on the "Theory of Potential;" beyond this latter point there is nothing which calls particularly for remark in the chapter. The issue of the work in parts is, we think, a very useful plan, as it practically forces the student who purchases the same (and many will do so), to study the subject systematically. A reprehensible practice is the insertion within the leaves of the work, of advertisements of quack electrical appliances.

How to Make a Dynamo. A Practical Treatise for Amateurs, by ALFRED CROFTS. Second edition, revised and enlarged. London: Crosby Lockwood and Son, 1889.

It may be flattering to the soul of the genuine amateur, for whom this book was written, to have himself placed in the same category with men like Faraday or George Stephenson, but it certainly savours of impertinence to the memory of these distinguished and lifelong workers, to find them classed with the amateur, with whom by no possibility could there be any trait in common. As an advertisement the treatise of "How to make a Dynamo" will be found useful to students, a very complete catalogue of works published by Messrs. Lockwood & Son being appended to another advertisement of where to obtain the castings with which to construct the said dynamo. Among other scraps of information to be gleaned from this work, is the statement that Varley claims to have originated the idea of compound winding in the series-shunt system; then the name of the immortal Captain Cuttle is dragged in in reference to making a note on something or another, but the name of his illustrious friend, John Bunsby, is omitted after the following oracular sentences, "For lighting a single semi-incandescent lamp, small Gramme castings of 60-candle-power can be obtained." "The bearings of these observations lays in the application of it," but that an't no part of our duty.

UNDERGROUND WIRES IN THE DISTRICT OF COLUMBIA, U.S.A.

THE question of removing all electric wires from above the surface of the street, and of their disposal in underground conduits, is one that is ever present to the officials of large cities, where electrical business is on the increase and the purposes for which the electric current is used are so various. In America this question is one of greater prominence than with us in Europe, and first brought itself into notice more than ten years ago, at a time when there was no practical utilisation of electricity beyond the requirements of the telegraph companies. The introduction of the telephone resulted in annoyance from the further number of overhead wires. Electric lighting has largely added to the number, while the wires for the transmission of power and for the operation of electrical tramways are steadily increasing, and bid fair to rival in number those of the other systems. The multitude of overhead wires is not objected to only on account of its unsightliness, but principally because the currents which the wires have to carry vary to such an extent that the stronger currents interfere with those circuits using weaker currents, danger from fire, and to human life when the potential is high. It has become increasingly important, in consequence, that the wires shall be placed underground, and it will be found that every day's delay only makes this more difficult to accomplish.

Major Charles W. Raymond of the Corps of Engineers, U.S. Army, in a report to the Senate of the United States on the subject of removing electric wires from the air or surface of the streets of Washington and placing them underground, has embodied the opinions of numerous communications received from the chief authorities and experts throughout the continents of Europe and America, and has drawn his own deductions from the mass of information to hand.

The majority of these communications are repetitions of what have already appeared in these columns, but one or two deserve notice. The proposal to construct a subway under the side-walks of the streets, to contain spaces for sewers, surface water drains, gas pipes, water mains and service pipes, and separate receptacles for electric light wires, and steam pipes for heating purposes outside of the general vault, would have many advantages over the piecemeal construction usually adopted; in the first place the roadway would be better for heavy traffic, and secondly, what would be of still greater importance, the necessity of breaking up the road for repairs or renewals would be entirely obviated.

The drawbacks to this plan, excepting where a new street was contemplated, would lie in the great outlay for its construction, and the compulsory alienation of the house vaults along the line of frontage to add enormously to the initial expense by way of compensation to the owners of the houses.

It is calculated that such a subway would cost some £100,000 per mile, an expenditure not to be lightly incurred even by rich municipalities.

In the following communication to Major Raymond, which we give *in extenso*, will be found the ripe and practical experience of a gentleman connected with perhaps the largest cable-manufacturing establishment in the world, and which is confirmatory of the opinion that for electric lighting cables there is no insulator that can compare with first class vulcanised India-rubber:—

As you are no doubt well aware, up to the present comparatively little has been done in this direction for electric lighting in Great Britain. We have been closely connected with such work as has been carried out, and, as telegraph engineers and manufacturers, we have been associated with many of the patents for various systems, but in the few notes herewith we propose only to refer to such cables and systems as we, at present, consider have proved most satisfactory.

Telegraph cables, underground.—We would at once point out that, as the telegraph work is in the hands of the General Post Office, and the telephone and electric light work has been carried out by many different private firms, no general system of conduits carrying wires for all purposes here has ever been tried in England. Our remarks will therefore refer to the laying of wires in iron pipes or trenches, where all the wires laid are for practically the same purposes.

To connect the submarine cables with the land lines we are often required to lay lengths of from 5 to 20 miles of single conductor cable underground. This has generally been a copper conductor insulated with gutta-percha and with jute, sheathed with iron wire, taped over all, and laid in an open trench. Some of these lengths have been working for many years, and they give practically no trouble where they have been carefully laid in suitable ground.

The cost of trenching varies much, say from, in some cases, 1s. 3d. per yard run, opening, laying, and making good, to, in other cases, as much as 5s. per yard run.

Post Office, England.—We have often been called upon to supply larger quantities of underground gutta-percha insulated wires for this department for use in large towns. This we understand has been drawn into iron pipes, and works satisfactorily, but no doubt you will have precise data on this system from the Post Office authorities themselves.

French Government.—We have supplied in large quantities for Paris and other large towns, wires insulated with gutta-percha and drawn into lead pipe, which have been laid in the sewers, or, as between Paris and Marseilles and in the provinces generally, have been used merely laid in an iron pipe, and we understand where fair care has been taken in the laying they give satisfaction.

Telephone cables.—For these we have tried many systems, but that generally adopted by English telephone companies is a number of wires insulated with gutta-percha and taped, the whole being laid up together into one cable. In these and other cables attempts have been made to overcome induction, with varying success, such as using a number of wires insulated and laid up together round a central core wire put to earth, or insulated wires covered with lead, and the whole laid up together, and with an overall sheathing of lead, the aim being to put an earth in the whole of the insulated surface. Amongst other systems of which we have had experience is Brooks's system, of which you have no doubt received details from the patentee.

Torpedo cable.—To connect observing stations with the fortifications, or with other stations, we have used single and multiplex core cables. These are invariably now insulated with India-rubber and laid in an iron pipe, or, if the cable is itself sheathed, laid in an open trench. Such cables have been found to work satisfactorily.

Electric light cables.—We have tried many insulators, but have come to the decided conclusion that up to the present date no insulator has been found to compete with vulcanised India-rubber, if well mixed, of good quality rubber, put on under great pressure and well vulcanised.

Of such a cable, when carefully laid, it would be difficult to estimate the life. In many cases discredit has been thrown on this insulator, especially in America, where the greater part of the underground work has been done, as the prime cost has been much more generally considered than the cost of maintenance.

We have made experiments with many other insulators in our own factory, the results of which have been so decidedly in favour of rubber, that for all outside work, and for the lighting of the factory, we have adopted cables so insulated, with the result that all the underground work we have done up to the present date has been in every way satisfactory, and in all cases where fair (but not excessive) care has been taken in laying first class rubber cables no failure has been met with. For electric light leads very little has been done in England by the local authorities, but a certain amount of work has been done by private firms, and though no system is much extended, there are a good number of short lengths under ground, and of them the principal of our manufacture are as follows:—

Locality.	Description of cable.	Length.	How laid.	Date.	Present condition.
		Miles.			
Eastbourne...	India-rubber insulated and taped over all.	7—8	In 3-inch iron pipe.	1885	Perfectly satisfactory; 2,000 volts alternating current.
Silvertown ...	India-rubber insulated and lead-covered over all.	*8	In concrete-lined, French	1882, 1883	Perfectly satisfactory; 400 to [illegible] volts arc lighting.
Colchester ...	Do. do.	...	Brick, French, two years.	†1883	Quite satisfactory; cable still in good state; 1,000 volts Brush.
London ...	India-rubber insulated, braided, and taped.	2	In iron pipe.	1887, 1888	Quite satisfactory; 2,400 volts alternating current.
Brussels ...	India-rubber covered and sheathed iron wires.	*5	In the sewers.	1887	Present condition is quite satisfactory; 1,400 volts constant current.

* About. † Taken up 1885.

In these installations the cost of laying has varied from about 5s. per yard, for 3-inch iron pipe with two cables, to about 8s. or 9s. per yard for a concrete trench to carry, say, 20 cables.

In addition to the installations named, there have been many short lengths laid in London and the provinces for continuous currents of from 100 to 400 volts, and in every case, as far as we know, the results have been satisfactory.

Of course, as already stated, the actual mileage is small, but the results are, in our opinion, very good, as we can point to successes wherever a good rubber cable has been employed, our great difficulty being to persuade customers that the first cost is not the only thing to be considered, and that if the cost of maintenance is taken into account the better, though more expensive, cable is really the more economical. We cannot help thinking that most of the reported failures of underground cables can be traced to the employment of inferior class rubber, or other cables which have been thoroughly unsuited for the work to be done, or to the laying of these cables being carried out by inexperienced men. We regret that the information we are able to lay before you is not more extensive, but we feel so certain of the practicability of using high voltages on underground cables that we have no hesitation in laying them whenever we get a chance of doing so, and we think that, from the absence of any failures in the work we ourselves have done, we are thoroughly justified in recommending such cables.

For outdoor work we are exclusively using those cables on the list marked "vulcanised," the class of insulation, and whether lead-covered or not, depending on the conditions of working and the manner in which they are to be laid.

The endeavour to place all wires underground has not been attended with any more success in Washington than in New York, as no matter how much wire has been accommodated underground, the increase of overhead lines has always been in a larger ratio. Although the problem in Washington is small compared with those of the large commercial cities, experience furnishes an interesting illustration of the above statement. Active operations to put the wires underground were commenced in 1884, and since that time have been continued without interruption. The results are shown in the following table:—

Year.	Conduits.	Underground Wire.	Overhead Wire.	Poles.
	Miles.	Miles.	Miles.	Number.
1883	...	...	767	2,623
1884	...	285·32	800	2,688
1885	...	859	850	2,900
1886	No	Report.		
1887	...	1374·8	937·25	2,934
1888	20·07	1671·86	2688·45	3,014

Although the number of poles has not increased to any serious extent, the mileage of overhead wires has multiplied nearly three times in one year, and if this continues as the normal proportion for the future, it will only be by some drastic and compulsory step that the evil can be abated. Major Raymond proposes to give one year for the companies to put their wires underground, and that after that time all poles remaining standing should be charge with a licence fee of [illegible] per annum each. Since the telegraph companies pay nothing for their privileges, there is no reason why they should not make the necessary expenditure. In the case of electric lighting wires all should, without exception, be placed underground, but permission might be granted during repairs, or some urgent necessity, for the temporary use of overhead conductors. It is recommended also that contracts be entered into with the several electric lighting companies, for terms of at least five years, for lighting the public thoroughfares of the city, the company or companies with whom these contracts are made to have the exclusive right to furnish electric lights to private establishments on the streets named in the contracts. It is considered that at the present moment the art of electric lighting is not sufficiently advanced to justify a municipality in undertaking the public supply on its own shoulders, but at a later period it may be thought advisable and economical to do so.

In underground conduits, as there is a danger from explosions caused by an accumulation of gas, ventilators should be provided through the lamp posts, and the covers to the man or hand holes should be lifted off occasionally during dry weather.

The English system of underground conduits used by the Postal Telegraphs may be reckoned the simplest, and should be efficient in most localities, in New York, however, owing to some peculiarity in the subsoil, the system is said to have failed.

In regard to the propulsion of cars on street railways there is hardly sufficient experience as yet to warrant the assertion that these roads, when constructed with underground conduits, are mechanically successful.

The working of the telephone lines is disturbed by arc light circuits, but the baneful effect of some electric railways in creating disturbing currents in telephone lines is very much more marked. They interfere not only in conversation, but also by permanently exciting the annunciator. These effects appear to be due less to induction than to the actual transference of electricity from the railway conductors to the telephone lines by way of the rails, the earth, or the telephone terminal ground lines. The difficulty occurs principally in connection with railway systems which utilise the rails for both outgoing and return conductors, or employ a single overhead wire, using the rails as a ground terminal or return. Railways having their main conductors in a conduit, and those employing two overhead conductors, one for the outgoing and one for the incoming line, can be constructed so as to produce no disturbance; but, as stated before, the mechanical success of underground conduits for the purpose is scarcely assured, and the overhead conducters will no doubt be soon a thing of the past, the only other system of propulsion to fall back upon without harmful result to the telephone circuits will be the employment of secondary batteries. Should the disturbing systems be compelled, as suggested, to alter their arrangements for current supply, the use of accumulators for furnishing the motive power for car propulsion should come into general practice, and on the most extensive scale.

CONDUITS, THEIR MATERIAL IN RELATION TO INSULATED CONDUCTORS.*

By A. C. CHENOWETH.

I HAVE the pleasure of presenting to this convention some observations in relation to sub-electrical conduits and insulated conductors. Many miles of structures of various kinds with insulated conductors in them are now to be seen in New York, Brooklyn, Philadelphia, and other cities. While the conduits themselves do not present any very important signs of decay, the conductors have given evidence of decomposition in various stages, and many have given out entirely. Those covered with rubber compounds having given place to the same protected by a lead covering.

Very little attention has been given to the subject of electro-chemistry, failure being attributed to various causes; remedies have been resorted to of a practical nature, suggested by mere circumstances, in order to counteract the supposed evil. That electro-dynamic forces have contributed to the trouble can hardly be denied. Creosoted wooden ducts and iron tubes are the prevailing forms of construction. Illuminating gas and moisture were found in most all of them. Rubber insulation was rapidly destroyed, and lead covered cables were corroded to such an extent in creosoted wooden ducts that other cables covered with an alloy of tin and lead were substituted, and even with these it was found necessary to coat with paint, hoping it would prevent any action from taking place. In the iron tubes corrosion was much slower.

After a careful examination of conduits and conductors, I am led to believe that this decomposition of insulation and covering is due to an electro-chemical decomposition.

The existence of thermo-electricity, or a natural voltaic arrangement in the earth is without doubt true. But the establishment of the principle that a certain electrolytic intensity is necessary before decomposition can be effected is of great importance to all those considerations which arise regarding the probable effect of the earth currents. For to produce an effect of decomposition or of combination, a current must not only exist, but have a certain intensity before it can overcome the quiescent affinities opposed to it, otherwise it will be conducted producing no permanent chemical effect.

In electro-chemical decomposition, the effect is produced by a force either super-added to, or giving direction to, the ordinary chemical affinity of the bodies present. In this view the effect is considered essentially dependent upon mutual chemical affinity of the particles of opposite kinds. Bodies dependent on weak affinities very rarely give way. Take, for instance, glasses—those formed by silica and an alkali. It is evident that all cases in which decomposition does not occur may depend upon the want of conduction. This being true, good conductors should never be selected for conduits, such as iron. Metals, owing to their high conducting powers, make admirable "poles," and yield to electro-chemical decomposition. It is true that some of the metals would not be decomposed, as they are costly and not available for use. The subject I present must be settled by weight of evidence rather than by simple philosophical conclusions.

I call your attention to a piece of cable that was removed from a creosoted wooden conduit in Brooklyn. The lead covering was eaten full of holes; it had been down over a year, creosote was attributed as the cause of decomposition; illuminating gas and moisture were present in the ducts: it was reported a rubber compound insulation was destroyed in the same duct; examination was made of iron conduits with lead covered cables in them, and decomposition was plainly seen in various stages, although the lead covering was not so rapidly decomposed as it was in a creosoted wooden duct; moisture and illuminating gas were present; the deposit on the surface of lead-covered conductors proved to be carbonate of lead.

In pursuing this examination I found a peculiar case that deserves some consideration. I found exposed to view in a manhole a cable that was covered with an alloy of tin and lead; this cable had been down about four months; it passed through the manhole on into the duct; the part exposed to view was about seven feet; the duct was constructed of iron and cement. On one side considerable decomposition appeared, being very active for about two feet of the exposed part which rested on the bottom of the manhole. A large iron pipe for water traversed the manhole parallel to the cable. The crystals of decomposed lead extended over toward the iron pipe, being quite profuse, adhering to the brick and side of manhole. An examination of the white crystals proved it to be carbonate of lead. Moisture was present, but no illuminating gas. I placed a piece of lead on the cable at this point; after two months I removed it and found the same covered with crystals of carbonate of lead, showing signs of electrolytic action, between the lead-covered cables and iron pipe, traversing that manhole, moisture acting as the exciting liquid.

I found in Brooklyn a cable that was conducted into a building some distance from a creosoted wooden duct; this cable was also decomposing in spots, while no odour of creosote or illuminating gas could be detected. The moisture may be the exciting agent, accelerated by creosote and illuminating gas. This action may be explained as caused by the reaction of the constituents of each portion of decomposable matter, affected as they are by the supervention of the electrical currents. Portions of the proximate or ultimate elements proceed in the direction of the current as far as they find matter of a contrary kind capable of affecting their transfer and being equally affected by them, and when they cease to find such matter they are evolved in a free state upon the surface of metals or air, bounding the extent of decomposable matter in the direction of the current. Hydraulic engineers frequently find an electrolytic action set up in stopcock valves under ground when they are made of two kinds of metals, the gate being brass, and main part of valve being of iron. Examination has shown that water impregnated with iron or saline matter has produced this action. I was informed by a very eminent engineer who is now chief of the Croton Aqueduct in New York City, that metals of different kinds underground invariably present marked evidences of decomposition when in contact. Faraday has shown that these electrolytic actions do not depend on contact alone.

In order to avoid any electro-chemical action, iron tubes, creosoted wooden ducts, or any material that can become the means of establishing this action, should be discarded for material neutral in its relations, like water, or triple silicate of lime, magnesia and aluminium, artificial stone. In case of pure water it is difficult of application, as the cable would have to be suspended in the water. Submarine cables last for a long time, except when they come in contact with certain soils, or meet with mechanical injury. It has been suggested to fill the conduits with water as water would absorb gas, changing its condition to an electrolyte, and establish an action with the metallic tubes for the purpose holding it.

A triple silicate of lime, magnesia and alumina, artificial stone, are constituents which, combined, form a substance more neutral than any other. The selection of this material for underground structures in form of concrete was probably the result of long experience rather than the knowledge of its material relations, as presented by electro-chemistry.

Attempts to counteract the electro-chemical action to a lead-covered cable by placing another substance in juxtaposition has not proved a preventive; it may delay it. Also the alloying of tin with lead. Metals may combine when melted together, but they do not remain combined after the solidification of the mass. I present here an example of this case. I refer to a piece of brass tube that was used for pneumatic transmission by the Western Union Company in New York, it being buried in a wooden box in one of the streets of New York. After it had been down some time it was so eaten full of holes that it required renewing. Upon examination you will find the zinc is eaten out, while the copper remains perfect; the action was on the outside, while inside the brass remained perfect; air traversed the inside continually, while moisture and other causes produced an electro-chemical action that I do not think can be imitated by any known arrangement of conditions so as to leave the copper as shown in this example; thus showing the peculiar effect of the earth currents in decomposing the zinc in this alloy, then removing it entirely. Moisture and gases must be removed by ventilation. In order to accomplish this, the diameter of the conduits should be not less than four inches, and some relative proportion should be established between the diameter of the cable and diameter of the duct, otherwise the power required to force air through would be beyond an economic limit.

The subject of ventilation for electrical conduits not only becomes necessary in order to protect the conductor in them, but in order to protect life and property. On Thursday, December 20th, 1888, an Edison manhole exploded in Maiden Lane, New York City; January 19th, one month later, an explosion took place in Nassau Street. In November, an Edison manhole exploded in Boston. These explosions have been attributed to accumulation of gas.

With a proper observation of the facts set forth and remedies suggested, we can combine the manufacture of insulated conductors, with a structure that will protect the insulation rather than destroy it, producing a perfect system of underground sub-electrical conduits and conductors.

RECENT TELEPHONIC INVESTIGATIONS.

ELECTRICIANS have so often had their preconceived ideas rudely shaken by the results of rigid experiment that the time for dogged persistence in past errors has almost passed, and new truths are assimilated with ease. Among such cherished ideas is the alleged infinitesimal strength of the ordinary telephonic current, a conception arising, no doubt, from the alternating nature of the telephonic current and the difficulty of constructing suitable instruments for its measurement. In referring to this subject in a lecture before the Boston Society of Arts, on work done at the Massachusetts Institute of Technology, Prof. Ch. R. Cross drew attention to the faulty construction of instruments intended for such investigations. Such instruments failed largely through the use of metal in close inductive proximity to the coil carrying the telephonic current to be measured, which gave rise to induced currents that weakened the original. Having removed this source of error by the construction of a galvanometer without metal, Prof. Cross finds that the average telephone current is far greater than is popularly supposed. The average current strength was not far from 0·5 of a milli-ampère, while an Edison Lamp takes one-half ampère, or only 1,000 times as much; and in the loud-speaking telephone it was 20 milli-ampères—an amount sufficient to give one a good shock. Lastly, it was found possible to transmit speech distinctly by a current which could not be detected by the most sensitive instruments. These currents, from 0·5 to 20 milli-ampères, were produced by speaking or sounding a loud note from an organ pipe into the transmitter. These results were also confirmed by experiments on actual working lines. Much more interesting, however, were the experiments on the New York long-distance line for the purpose of estimating the losses. For this work granulated carbon transmitters were used. In talking to New York practically all the current passing into the line traversed the instrument and was measured. The operator in New York then talked over the line, and the current, less the loss, was found to be 0·01 to 0·02 milli-ampère, while when entering the instrument before passing over the line it was 10 to 20 milli-ampères, giving a loss of over 99 per cent. The actual working current was, therefore, exceeding small—in fact, absolutely much smaller than on the city lines. There should have been no unusual losses, as the day was perfectly clear. That the service over the long distance lines should be so good is evidently due to the use of a metallic circuit of low resistance and retardation, and the sounds were clearer and more easily understood than on the city lines. The value of the current as determined by the material and shape of electrodes was also studied, and carbon, platinum, iron, and copper employed in various combinations. Carbon with carbon gave a large range of variation, platinum on platinum a greater range, which fell off suddenly. With iron the curve was low. In altering the electrodes a curious point was noticed, for it makes considerable difference which is the anvil electrode. It was found that the anvil is the governing electrode, for, with carbon as the anvil, the curve is like that of carbon for both, although the other may be of iron.—*Electrical World.*

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* Paper read at the Convention of the National Electric Light Association, Chicago.

AMERICAN NOTES.

By DAS TELEPHON.

A NOVEL concert took place last week in the Franklin Institute in Philadelphia, the music being sent from New York by phonograph, and what is ridiculously called the long-distance telephone. Several of Patti's choicest notes were sent over the line to the infinite delight of several hundred persons who had many a time and oft listened enraptured by the diva's voice.

It seems Patti has met her fate at last, as the Wizard of the North, as Mr. Edison is fondly termed, proposes, with his long-distance graphotelephone to organise a music trust in New York to furnish opera and concert throughout the length and breadth of this great continent.

The long-distance telephone of the Bell Telephone Company at present extends from Boston to Philadelphia through New York, a distance of about 700 miles. That company is now rapidly extending it to Baltimore and Washington, 150 miles farther. It is said they use a copper wire weighing 170 lbs. to the mile, and place 50 poles where the old lines use only 25 poles. In the underground system they complain that they are hampered to a great extent, as they are able to work effectually only a six mile circuit.

The last phase of the great electric sugar swindler is the application of Mrs. Friend, the widow of the arch deceiver, for the return to her of a trunk of private papers, which had been seized under an order of the court. The only importance attached to this phase is that the widow says that in the trunk was the formula for the electric sugar refining process, which, however, she says is in cypher; yet she is particularly anxious that no one should get hold of it.

In these "Notes" has been recorded the transfer of telegraph operators from the operating table to the Judicial Bench. Let it now be recorded that a gentleman, who some ten years ago was a telegraph operator receiving the usual salary, is now the owner of several millions of dollars, and has been the president of the Edison Electric Light Company of New York for several years, and in the last "deal" he figures as the owner of 2,000 shares of the Edison General Electric Company, par value, $100; and this is only a portion of his wealth, all of which he has acquired by a judicious application of his knowledge of electrical matters. This person is none other than Edward H. Johnson, who doubtless is well known by many of your readers as the representative, electrically, of Mr. Thomas A. Edison. Mr. Johnson has a magnificent estate on the shores of Long Island Sound, where he entertains his friends right royally.

A telegram from the City of Mexico, of 7th inst., informs us that the merchants of that city have decided to establish a new telephone company, in consequence of the very bad service now rendered by the Bell Telephone Company.

The denizens of New York are having lively times from the explosions which occur frequently from the manholes of the underground electrical conduits.

A few days ago there was a report like the discharge of a cannon near the U.S. Sub-Treasury Buildings, in which are stored countless millions of Uncle Sam's surplus, and it was the general belief at first that it was a bold attempt to blow up the building, and in the *melée* to carry off untold gold; but it was nothing but an explosion in a manhole, the iron cover of which was thrown up into the air some 15 feet, and the asphalte pavement was thrown up also, leaving a hole some 15 feet in diameter and 4 feet deep; clouds of dense black smoke, steam, and foul gases escaped. It is a telephone and telegraph subway, and had not been opened since it was built some four months ago, and it is supposed that it became filled with escaping gas, which, becoming mixed with air, thus produced the explosion. This is the third explosion within the past three months.

It is said that if a hole is sunk 2 feet deep in any part of the streets of New York, and a lighted match be put in it, a flame of gas will burn for several minutes. Oh, what a charming volcano lies beneath that great city!

I again invite the attention of inventors and patent attorneys to the recent decision of the U. S. Supreme Court on the duration of a U. S. patent.

In England the law requires the payment of a tax annually or at other stated times. Heretofore the lower courts decided that if a patent once became operative in the United States, it does not lapse until the end of the time for which the foreign patent was granted, so that a lapse of a foreign patent by reason of non-payment of the tax did not cause a failure of the same patent in the United States. The recent decision overturns this doctrine, and makes a lapse of the patent in a foreign country, from any cause, destroy the efficacy of the U. S. patent, unless the U. S. patent had been issued prior to the issuance of the foreign patent.

The Supreme Court says: "These provisions of the Act of 1870 and of the Revised Statutes mean that the United States patent shall not expire so long as the foreign patent continues to exist, not extending beyond 17 years from the date of the United States patent, but shall continue in force, though not longer than 17 years from its date, so long as the foreign patent continues to exist."

The Solicitor-General of the United States has accumulated a great deal of evidence touching the first invention of a speaking telephone, as also touching the irregularities in the granting the famous Bell patent of 1876.

He will be able to prove by actual experiment that a telephone somewhat after the Reis transmitter, described in a book published prior to 1870, will transmit electrical currents by which articulate speech is reproduced distinctly and loudly. A few days ago I had the opportunity of testing such an instrument with an improved Bourseul receiver, and sentences were clearly and loudly reproduced.

The transmitter is the square box form with the little tripod, with platinum contacts. I carefully examined the instrument and compared it with the description in the book, and I find it made strictly according to it. I was informed that that description was given to a workman without any other instructions, and he produced the instrument which I examined.

Washington, *February 8th*, 1889.

The following extracts from the Report of the Commissioner of Patents for the year 1888 may be interesting to inventors and patent attorneys:—

"1. *Date of the patent.*—Section 4,885 Revised Statutes provides—Every patent shall bear date as of a day not later than six months from the time at which it was passed and allowed, and notice thereof was sent to the applicant or his agent; and if the final fee is not paid within that period the patent shall be withheld. This provision enables an applicant who fails to pay the final fee within six months after the allowance of his application to prolong the monopoly of his patent the period of six months, and it not infrequently occurs that parties having what they regard to be valuable inventions permit their applications to forfeit in order that they may avail themselves of section 4,897, which allows them to make a renewal application for the same invention upon the payment of a new fee, but without filing any new papers, the original application, specification, and drawings being used.

"2. *Limitation of term of United States patent by foreign patent.*—Section 4,887, after declaring that no person shall be debarred from receiving a patent in this country for his invention or discovery, nor shall any patent be declared invalid by reason of the invention having been first patented or caused to be patented in a foreign country, provides—But every patent granted for an invention which has been previously patented in a foreign country shall be so limited as to expire at the same time with the foreign patent, or, if there be more than one, at the same time with the one having the shortest term, and in no case shall it be in force more than 17 years. It is understood that the object of this legislation originally was to prevent an inventor from allowing the people of foreign nations to come into the free enjoyment of his invention at an earlier period than was permitted the people of our country, which earlier enjoyment resulted from the fact that the term of American patents is much longer than any allowed by foreign governments, so that it was impossible for an American inventor to take out a foreign patent without disclosing and making public his invention after the expiration of the shorter term in such foreign country. In the meantime the American people were excluded from the free enjoyment of the invention during the period intervening between the expiration of the foreign patent and the American patent. But I believe those conversant with the subject have never seen any wisdom in this provision of the law. A great deal of trouble and annoyance have resulted from it to inventors, both American and foreign, without, so far as is known, advantaging any one.

"7. *Delay in prosecuting applications.*—I desire to call especial attention to the subject of the delays which occur in the Patent Office on the part of applicants in the prosecution of their appliations for patents. Section 4,894 provides—All applications for patents shall be completed and prepared for examination within two years after the filing of the application, and in default thereof, or upon failure of applicant to prosecute the same within two years after any action therein, of which notice shall have been given to the applicant, they shall be regarded as abandoned by the parties thereto, unless it be shown to the satisfaction of the Commissioner of Patents that such delay was unavoidable. Under this section applicants who desire to prolong their applications and postpone action therein have an ample opportunity to do so. There are two classes of persons who apply for patents—*one* composed of those who are exceedingly anxious to obtain their patents at the earliest practicable moment, the *other*, of those who desire to prolong the issue of their patents and to keep the application pending in the Patent Office to the very latest date possible. The second class embraces the more powerful, rich, and influential parties, who are either the inventors or the assignees of the inventors. This section of the statute enables the second class of persons to keep their applications pending in the office for years before their patents issue. In the meantime they are engaged in manufacturing and putting upon the market the article or improvement, but warning the public that the patent is applied for, the effect of which is to give them the absolute control and monopoly of the invention, and to deter all other inventors from entering upon the same field of invention and from manufacturing the article. The manner in which this delay is effected may be briefly explained: The applicant files his application and is allowed two years within which to complete or perfect it. Any action of the Office requiring change, or modification, or some formal correction can be followed under this section by a further delay of two years before the applicant is required to take any action in response. At the expiration of the two years he, perhaps, makes some amendment or change in the character of his claims. This involves a corresponding action on the part of the Office, and however prompt and speedy this action may be the applicant is permitted another two years before any responsive action can be compelled from him. And so the matter may be continued. There are applications now in the office which have been kept alive nine or ten years, and the Office is powerless to compel speedier or earlier action on the part of the applicants.

"I earnestly recommend that section 4,894 be so modified that there shall be vested in the Commissioner of Patents a discretion to declare any application forfeited for want of prosecution whenever he shall be satisfied that such order should be entered."

Attention is particularly invited to this recommendation of the Commissioner of Patents. Such a power placed in the hands of a Commissioner of Patent would invest him with power to prevent any person from obtaining a patent if he, or the examiner, should entertain any prejudice or ill will against an applicant for a patent. The exposures in the daily papers of the frauds, delays, and vexatious proceedings of the Patent Office under the present commission have created a feeling of disgust and dissatisfaction with the operations of the Patent Office of which the next Congress will take official notice, and it is expected that the assumed power of examiners and of the Commissioner of Patents will be severely rebuked, and the entire government and rules of the Patent Office will be remodelled: and it is sincerely hoped that the incoming President will select for Commissioner an honest and able lawyer and not a fourth-rate shyster from some one-horse town.

Articles of incorporation of the "New Jersey Phonograph Company" have been filed in the proper office in New Jersey. The capital is set at $625,000. This company will have the exclusive right to lease and sell the phonograph and graphophone in New Jersey of the Edison-Tainter and Bell patents.

In the State of Illinois a Bill to fix the rate of telegraphic and telephone messages between points in that State has been introduced into the Legislature; for 350 miles or less, 15 cents for 10 words or less, and 20 cents for 10 words, and 2 cents each additional word for distances over 350 miles.

At a meeting of the American newspaper publishers in New York there were exhibited several machine type setters. The greatest curiosity exhibited was an *electrical* type setter. It does away with ordinary type and yet can turn out a beautiful specimen of the dry matrix, column measure, suitable for newspaper plates.

An electric design is announced which is to photograph burglars in *flagrante delicto*. The apparatus can be so arranged that a burglar entering a building must touch something which will cause a sudden flash of light, and the result will be, his photograph left on the prepared plate. The application is for a patent for "An Electric Light Method of Instant Photography."

The "Electric Sugar people" who were arrested for fraud, have failed to obtain a release from prison on the hearing of the return of the writ of *habeas corpus*, and they will, no doubt, be brought to New York, where indictments have been found against them. The papers here are teeming with statements about this swindle, but there does not seem to be any sympathy for the too willing dupes.

The American Bell Telephone Company with its usual astuteness, has obtained an extension of time to file its answer to the Bill brought by the United States to annul the Bell patent for fraud, from the 9th to the 23rd inst., thus preventing the present Solicitor-General from prosecuting the case, no doubt with the hope that the successor in the office of Attorney-General will see good reason for dismissing the suit, which, I think, is likely to be the case, for the simple reason that no fraud can be proved against the patent.

ABSTRACTS
OF PUBLISHED SPECIFICATIONS, 1888.

531. "Improvements in and means or apparatus for and connected with the generation, distribution, measurement, and control of electricity." H. Edmunds. Dated January 12. 11d. Claims:—1. In or for generating and distributing electricity a prime motor provided with means for maintaining the pressure which operates it constant, in combination with an electric generator producing a constant current and having a variable speed according to the electromotive force required by the work. 2. In a system of generating and distributing electricity a prime motor with a pressure automatically maintained constant operating a prime electric generator producing constant currents operating secondary motors connected with secondary electric generators producing constant currents, which currents automatically re-act on the whole system varying the speed and electromotive force according to variations in the work. 3. In combination with the subject matter of the preceding first claiming clause, an electric motor or electric motors arranged and operating, substantially as and for the purpose described with reference to the drawings. 4. In combination with the subject matter of the preceding first claiming clause an electromotive generator, arranged substantially as and for the purpose described with reference to the drawing 5. The method of or means for joining and insulating electric conductors. 6. The general arrangement and combination of parts constituting the means or apparatus for generating, measuring, or controlling electricity, substantially as described and illustrated. 7. The cut-out described and illustrated in the accompanying drawings.

1091. "An improvement in or connected with counting or recording mechanism released electrically." D. A. Aird. Dated January 24. 8d. Relates to certain means or appliances for ensuring a positive and reliable record of the number of persons passing a given spot, turnstile, or the like, as a perfect check to the amount of money received for admission to places of amusement, or resort, said invention being also applicable for registering the rotation or motion of shafts, or other pieces of machinery, or for other like useful purpose. The invention is connected with clock gear kept ready for action by a spring, the escapement pallet being governed by and forming part of a balanced or weighted armature, the movement of which, by a magnet, is regulated from each action of a turnstile or other pieces of mechanism, this being utilised to make circuit. The weighted escapement pallet balanced armature is the chief novelty of the invention. The claims are 2 in number.

1254. "Improvements in forming metallic connections with incandescent electric lamps and holders therefor." J. Spink and C. Gauzentes. Dated January 27. 8d. Consists in attaching a wire or stem to each platinum link, and securing the same in position by enclosing and protecting them for some distance from the lamp by a collar, and filling the space with suitable insulating cement; the contact with the holder being effected by the stems projecting from the lamp and inserting them into the centre of spiral wire springs connected to the two lamp holder terminals, and inserted in holes formed in the holder, to which are also secured arms for carrying a reflector, the latter being secured or held in position by movable arms placed above the reflector. The claims are 3 in number.

1798. "Improvements in telephonic transmitters." T. Laurie. Dated February 7. 8d. The main object of the invention is to dispense with diaphragms, sounding boards, tympanums, or analogous sounding bodies. This is effected chiefly by means of a piece or disc of carbon with a hole through it and divided into two separate parts, by having a piece of fibre or any other insulator between the two parts. The piece or disc of carbon is also fluted and upon this is laid a ball or other suitably shaped piece of carbon so that the sound waves of the speaker's voice may have access to it freely. This arrangement is connected with the transmitter, so that whenever the transmitter is spoken into the sound waves play upon the loose ball or other shaped loose piece of carbon, and as it is very light it oscillates and makes and breaks contact upon its fluted base. Each of the pieces of fluted carbon of which the disc is composed are connected by a metallic (preferably a copper-covered wire leading to a battery line) wire and receiver. The sound waves are carried through the receiver and line wire to the receiver at the other end of the system. The claims are 2 in number.

1843. "Improvements in rheostats and Rheotomes." J. C. Mewburn. (Communicated from abroad by La Société Anonyme pour la Transmission de la Force par l'Électricité, of Paris.) Dated February 7. 8d. Relates to liquid resistances. The claims are 10 in number.

1919. "An improvement in arc electric lamps." A. J. Howes. Dated February 8. 8d. The inventor attaches the upper carbon holder to a tube of non-magnetic material which is free to slide vertically within a fixed solenoid, this solenoid being wound with two coils, one of low resistance in the main circuit of the lamp, and another of high resistance in a shunt from the lamp circuit, connected in such a way that the current in the latter coil is opposed to the current in the former. Within the tube that can slide in the solenoid are two semi-cylindrical pieces of soft iron, which, hanging side by side, nearly fit the tube, but are magnetically insulated from each other by facing with paper or other suitable material their flat faces. These pieces are connected by cords or chains passing over pullies to the lower carbon holder, with such additional weights as may be necessary for nearly balancing the system. The action of the lamp is as follows:—Assuming the two carbons to be in contact, the iron pieces in that case extending some distance below the solenoid, then almost the whole current passing through the low resistance coil excites the solenoid, so that the two pieces of iron are magnetised and also attracted upwards. Being magnetised with the same polarity, they repel each other laterally, and so press on the tube enclosing them that they have sufficient frictional hold to move the tube along with them. Being attracted upwards, they raise the tube and thus separate the carbons till the arc is struck. As the carbons, by consuming, become further separated, so that the arc acquires excessive resistance, the main coil of the solenoid and the shunt coil neutralise each other, the iron pieces become more or less demagnetised and lose their frictional hold of the tube, which descends, bringing the carbons near to each other. The claims are 3 in number.

2073. "An improved electric alarm apparatus." A. C. IWANOWSKI. Dated February 11. 8d. Claim:—A self-acting apparatus for indicating and preventing fire, consisting of a hermetically closed vessel or case, one side of which is thin and serves as a flexible diaphragm for automatically interrupting and closing of the signal circuit, and setting in action an alarm bell and any other signal apparatus, in consequence of an increase of pressure inside the vessel owing to an increase of heat.

2251. "Improvements in switches for electric circuits." A. GRAHAM. Dated February 14. 8d. The object of the invention is to provide a simple and efficient switch by means of which contacts can be made for communicating with different places, which switch, on being released automatically returns to its normal position, in which the circuit, with its bell, annunciator telephone, or instrument, is completed. There is 1 claim.

2368. "An improved method of manufacturing woven plates for secondary batteries." M. BAILEY and J. WARNER. Dated February 16. 8d. The inventors prepare a network preferably of lead or other suitable wire, ribbon, or strips, and having a selvage at the edge; two, three, or any suitable number of such wires, threads, or ribbons are interwoven, preferably in the longitudinal direction of the plate, with one, two, three or more threads of cotton twine, silica cotton, or spun asbestos fibre, so that each metal wire or wires, threads, or ribbons is separated thereby. The claims are 2 in number.

2438. "Improvements in the manufacture of illuminating conductors for incandescent electric lamps." R. LANGHANS. Dated February 18. 6d. Claim:—A filament for electric incandescent lamps consisting in a vein or core composed of one or more of the oxides of calcium, magnesium, barium, strontium, aluminium, beryllium, cerium, lanthanum, didymium, erbium, terbium, yttrium and gallium, and one or more of the oxides of titanium, uranium, siconium, molybdenum and thorium, the said vein or core being coated with carbon, silicon or boron, substantially as set forth.

2450. "Improvements in electrical measuring instruments." W. HIBBERT. Dated February 18. 8d. In one form of instrument, two magnets are suspended vertically, parallel to one another, with their north poles downwards. Midway between them rises the conductor, a vertical wire, conveying the current parallel to the magnets until it reaches the equatorial region or middle of the magnets, where it is bent at right angles so as to run in a horizontal direction. The two magnets are held above by a disc carrying an agate cup which rests on a needle point. The disc carries a pointer moving in a horizontal plane over a scale, and there is also attached to it the lower end of a controlling spring. When a current flows in the conductor it acts on the two north poles only, and on them in the same direction as far as rotation is concerned. In rotating, the poles remain at the same distance from the wire, and therefore give deflections of the pointer proportional to the currents acting on them. The claims are 3 in number.

2525. "Improvements in arc electric lamps." C. RICHARDSON. Dated February 20. 8d. The peculiar combination of a specially-shaped frame escape wheel with arbor and pinion or pulley gearing with a palate on whose arbor is a balance, forms the chief feature of the invention. There is 1 claim.

2586. "Improvements in and relating to incandescent electric lamps." R. KENNEDY. Dated February 21. 8d. Claim:—In an incandescent electric lamp the construction and use of a continuous incandescent conductor, consisting of two rods or carbons laid or inclined at an angle, and joined or cemented together at their one end or apex, and at their other end to the platinum wires or conductors, substantially as described in reference to and shown in the drawings.

2784. "A method of and apparatus for electrically lighting railway and other carriages." J. IMRAY. (Communicated from abroad by R. Imray, of South Australia.) Dated February 24. 8d. The inventor joints a lever at one part of its length to the carriage body, at another part to an axle or axle box, and at a third part to a pawl lever engaging a ratchet wheel or working the equivalent for pawl or ratchet, usually known as "silent feed," so that, as the carriage moves up and down on its springs, the feed wheel is intermittently turned in one direction. This wheel is arranged to wind up a spring or series of springs, which through suitable gearing drive a dynamo-electric machine, the terminals of which are connected by suitable conductors to an incandescent electric lamp or to several of these in the c The spring or springs employed are such as to const reservoir of power continuing to drive the dynamo-el machine for some time while the carriage is at rest, but the also be an accumulator battery employed to regulate the c and to continue it for some time after the spring pow exhausted. The claims are 2 in number.

11082. "An improved mode of and apparatus for trans and recording electrically autographic messages, signals, markings." P. A. NEWTON. (Communicated from abroad E. Gray, of America.) Dated July 31. 1s. 3d. Consists in method of and apparatus for transmitting and recording a cha by the movements of a transmitting pen and a receiving pen, transmuting the movements of said transmitting pen into pul tions, of substantially the same effective strength, in an elec circuit varying in number with the linear extent of the movem of said pen and varying in speed of succession with the rapidity said movement and transmuting said pulsations into movem of the receiving pen. The claims are 6 in number.

CORRESPONDENCE.

Cable Testing.

It is, I am afraid, a rather stupid question I am going to ask, but still I should feel very much obliged if you would give me a couple of lines as an answer. In testing a submarine cable for copper resistance there is nearly always found a difference between the readings obtained with zinc and copper. This difference is due to earth current; but how shall I correctly state its nature, + or − ? If the readings with copper are greater than those obtained with zinc, is it correct to say that the earth current is + or is it − ? For instance, readings with copper = 550; with zinc 500; deflections from earth current 150; are these 150° to be described as + or − ? In other words, does an earth current of the *same* nature as the current with which the single readings are obtained *decrease* or *increase* the resistance? Apologising for troubling you,

Tyne.

March 16*th*, 1889.

[The point you ask information on is dependent upon the way the connections are made on to the bridge. Supposing, however, the connections are so made that the testing battery causes a zinc or + current to be sent *out* to line, then if the resistance required to produce a balance under these conditions is *higher* than the resistance required to produce a balance when the testing battery is reversed, the earth current flowing *to* the testing station will be +, *i.e.*, the direction of the current will be the reverse of that sent by the testing battery. Or we may say that the earth current flowing *from* the testing station is −.—EDS. ELEC. REV.]

Problems and Conditions of Ocean Telegraphy.

> Ah, me! what peril doth environ
> The man who meddles with old iron.
>
> HUDIBRAS.

In your zeal in defending iron-armoured cables, in your issue of the 15th inst., you fell into an error in supposing I had addressed anything on the subject to a scientific journal. The "high-sounding" title at which you sneer was that of the editor of the *Electrical World*, of New York, to me unknown, who had warmly endorsed remarks of mine which he found in a mere provincial journal.

If you had published my language as he did your readers would have wondered why sarcasm so largely prevailed over science in your long article.

All I asked was that no more public money should follow the millions which have been spent over rapidly decaying ocean cables, *without due enquiry*. You seem to think no such enquiry should take place. I have before me, I think, all the evidence you possess, and though I admit much of it is of a scientific nature, cannot admit that any other skilled knowledge is required to arrive at a conclusion than that which properly enables us to weigh testimony.

All the superiority you can claim in respect of your scientific attainments is that you are entitled to produce yourself as a witness. But you are only one witness. And much as I respect science in this case, if you cannot claim experience or skill in weighing evidence you have little to boast of.

I have endeavoured—not in vain, I think—to make myself familiar with all that has been furnished respecting the different cables you mention. The greater part of your long argument is applicable to shore ends, and not to all shore ends, but only those which are laid in exposed places, a subject not now under discussion, and which I must be permitted resolutely to insist on dismissing from consideration. That involves a question where abrasion or injury from *mechanical* causes is sometimes involved in addition to *chemical* causes, and I think we may fairly agree to put all that out of the way for the present.

This discussion relates solely to the deep sea and other undisturbed waters where corrosion is rather rapidly destroying all that remains of the iron and the contiguous core.

I am aware that much of what you describe as "bird-caging" has been discovered, but how in such cases—the result of the decay of hemp from contact with iron and from want of protection—does the core become fractured or traffic interrupted, as in the case you cite of the cables of 1860? Will you give us instances, or aid us by scientific opinion, to enable us to say how "bird-caging" should enter into the controversy?

In this view I observe you refer to the failures of the West India cables of 1870, 1871, 1872, as being "not due to *iron wires*, but to the *nature of the bottom*." This is correct if the "bottom" injured the wires; but if not, what on earth did produce the failures? Talking of the West Indies, I observe parenthetically that according to the chairman's report for 1886 the Trinidad-Demerara cable has been again interrupted; interrupted 12 times since 1879. There is something in the mud poured from the rivers which has a deleterious effect on the iron wires.

Where iron is recovered, as I admit it often is in a perfect condition, this proves that there the ground is favourable. Where the bottom is favourable to iron, it is favourable to hemp; but where unfavourable to iron, it is not unfavourable to hemp. The old maxim that the strength of the chain is measured by its weakest link is applicable to the iron armour.

You speak of the *rotting* of hemp. At present I do not remember ever to have seen any trace of decay in submerged *tarred Russian hemp*. And you cannot, I think, suggest any possibility of injury of any kind to hemp under salt water if properly treated with a compound of pitch silica and tar, such, for example, as "Bright's compound." You admit you must cover your iron-armoured cable. But why encase iron to go on "burning up" inside? If you use hemp alone with the protection, there will be no chemical action of the iron to open the door to insects or other enemies. I think the evidence strong upon which to pronounce a hempen cable practically indestructible—"a cable of perdurable toughness."

In one obscure sentence it might be inferred that you say hemp is liable to be injured by vegetable action, but I doubt whether ever such a case was known. I am sure there is no vegetable in the deep sea injurious to hemp.

Yesterday, one of those arguments most loudly urged against a hempen cable, which are one by one vanishing, was that it could not be sunk; but the insertion of 50 miles of this type in the Brest-St. Pierre cable has so thoroughly silenced this contention, that I observe you do not even allude to it.

The stale argument respecting the grapnel is, however, alluded to. I am astonished that you are not aware that by means of an automatic grapnel the instant of the hooking of the cable is known on board. I do not know that you could have found this out at "Jebel-Teir," but there are numbers of sailors in Halifax who could have enlightened you. Have no "dread of danger" on this score, for there is no officer on a cable ship who will now admit that he would have the slightest difficulty in bringing on board a hempen cable without the damage over which you grow quite pathetic.

I will pledge myself to produce the men, whenever required, who can even more easily raise an unarmoured than an armoured cable. A single practical test will settle this, and why should controversy continue?

If you are as incorrect in your other assertions as you are respecting the Dartmouth cable, I am to obtain little benefit from your statements. You will find upon enquiry that the bottom on which the two cables are laid is extremely rocky, and the water is swarming with animal life, and the merest tyro in physical geography would not venture to set up the theory of stagnant water in such a locality. I leave you to deal with the inventors as to your statement that they have deceptively chosen the locality. You will perceive that I am not relying on this cable to advocate hemp for shore ends; but if this cable can endure, with absolute immunity here, how much more likely to endure in the deep bosom of the ocean buried.

You seem to think the successful insertion of 50 miles of hempen cable in mid-ocean goes for nothing. I must say it seems difficult to satisfy you. I fail to see why 500 or 1,000 miles would afford stronger evidence. You are aware it was predicted that the buoying, heaving in, and all the vicissitudes attendant upon submerging a hempen cable would be fatal. I wish to inform you that on a former occasion about 80 miles of new new wire cable was abandoned after it was inserted in an attempt to repair this same cable, and the entire operation cost that season about a hundred thousand pounds.

In regard to the projected Canadian-Australasian line you seem to think you can avoid very great depth. I hope you may not be disappointed. The public here in Canada would like to know what is *your* route. Mr. Sandford Fleming was the representative of Canada at the Colonial Conference in London. He was there for the sole purpose of advocating that cable. I suppose you are familiar with his rival route in opposition to that of Field. He admits a necessary depth of 3,300 fathoms. If, as you say, your close-sheathed cable is liable to be "bird-caged," what would be the situation of a company with 6,500 miles of such a frightful wreck of iron in such depths on the first casualty?

You even deny that greater speed can be obtained by abolishing iron. I do not pretend to offer data. I am in the hands of those best able to judge. In the *Electrician* of the same date in which you paid me the compliment of noticing me, I find that "it must be conceded that the absence of the iron sheath should tend to facilitate higher speed of working." There are about 2,000 tons of iron in an Atlantic cable. Can anyone doubt what would be the effect on speed of removing all this rubbish.

I remember having read in an English electrical magazine in 1882 or 1883 the report of an interesting discussion in which it was perhaps for the first time asserted as a striking and important discovery that torsion was the real cause of the destruction of iron cables. I then resolved at my leisure to make an exhaustive enquiry into the subject. I speak now from actual experiments. Grasp firmly, so as to prevent untwisting the end, and uncoil a length of about 30 fathoms of cable, firmly lashing the end to a fixture. Now with a file cut into the wires, taking care not to completely sever them. They will all snap together. The cable on either side of the cutting will revolve with more or less rapidity in opposite directions, and the core will almost instantly be twisted asunder.

This filing represents what Prof. Tyndall calls the slow burning of the iron which destroyed the first Atlantic cable, and which is destroying all the others. The whole story is summed up in the one short word—resilience. Science teaches us how these lines are constantly becoming twisted off as clearly as if the sea was parted and we could travel along the ocean bed and witness the devastation with our eyes.

Robt. L. Weatherbe.

Halifax, Nova Scotia,
February 28*th*, 1889.

Telegraph Tariffs.

The 11,882 and 6,487 "cartes-télégrammes" mentioned in my writing in the *Journal Télégraphique*, of which your issue No. 587 gives a translation, are not similar to the "télégrames-cartes" in vogue in France, as the denotement "pneumatic messages" should make believe, but a special kind of telegrams, such as are only admitted in Holland, but merely on New Year's Day, although they may be handed in on the preceding 31st December.

Those telegrams, which may contain but the names of the addressee and the sender, are transmitted when no other messages are in the way. They are written on cards and charged twopence apiece.

At the first trial (31st December, 1885—1st January, 1886) the public handed in 11,882 of those cards, but the following years the number was much less, viz:—

6,480 (31st December, 1886—1st January, 1887);
3.692 („ „ 1887 „ „ 1888);
3,330 („ „ 1888 „ „ 1889).

It hardly need be brought into relief that undoubtedly a much larger traffic could be expected if the use of some text were allowed, as I still hope that will be granted some day.

Linckens.

The Hague, *March* 18*th*, 1889.

Siemens's Recording Apparatus for Compact Morse Writing (Patent).

With reference to the article which appeared in your issue of the 8th instant, it is a trite saying that "History repeats itself," and it would appear that a resurrection of old moribund ideas periodically takes place.

A re-arrangement of Morse symbols has been considered at various times, not only on account of economy in the matter of paper strip, but also as tending to increased rapidity of working; and so far back as 1864, I submitted a proposal of the sort to Mr. Varley, as the attached copies of correspondence will show.

After the despatch of my second note, I saw Mr. Varley, and he then convinced me that on account of some words and letters being more frequently used than others, and having fewer units, there would not be a saving of 50 per cent. as stated, but he admitted that in actual working the proposal would at least give 14 per cent. increase in speed.

I have also some recollection of a proposal made by Mr. John S. Gisborne with the same object as the present, his system being the use of dots and dashes, placed vertically on the paper strip.

Jno. Wm. Fletcher,
Assoc. M. Inst. C.E., and M.I.E.E.

March 18*th*, 1889.

[COPY.]

Holyhead, *January 23rd*, 1864.

C. F. Varley, Esq.

Sir,—I notice in the *Electrician* of the 8th instant, a paragraph headed "The Typo-telegraph" *versus* "The Morse System of Signalling," from which it appears the superiority of the former is claimed over the latter, inasmuch that where Bonelli's system would reach 10,000 words per hour, 5 "Morses" would only attain 5,000 words per hour. Now, by a slight alteration in the Morse instrument (and using my relay, now in making), but still adhering virtually to the present alphabet, 10,000 instead of 5,000 words per hour might be sent, or, as Mr. Culley gives the average at 24·5 words per minute, of course 49 words per minute would be realised, or 5 Morses would turn out 14,700 words per hour, exceeding Bonelli's by 4,700, using the exact number of signals as at present, but differently arranged.

To all interested in the well-being of the Morse system, provement—at the present stage of telegraphy, when seems to be the main question at issue—must cert invaluable. &c., &c.

I am, Sir,
Your obedient servant,
(Signed) JNO. WM. FL

[COPY.]

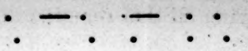
The Electric and International Telegraph Co
Engineer's Office,
Telegraph Street, Londo
February 1st,

Dear Sir,—I have your note, but have had other m attend to.

The Morse instrument, as at present worked, gives us words per minute, but this is faster than we can get it down by clerks, which latter is our chief limit of speed.

If an instrument were made working 60 words a min the clerk could only write 20, the result would be tha message had been sent a long while would elapse before th could write it out—the instrument would be idle all th Thus you see that an instrument that will work twice as our present will not be of a proportionate value.

It has been proposed to work a telegraph with two marks—in fact it was worked for years in Germany, thus—



this seems a great gain, but on trial it is found that it quicker than the single line of marks in the ratio of 72 say, as 5 to 7. The disadvantages are, however, greater th gain, and consequently the old Morse holds its ground st &c., &c.

Truly yours,
C. F. VAR

[COPY.]

Holyhead, *February 2nd*, 1

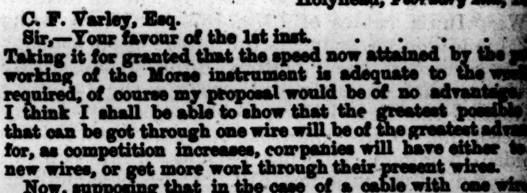
C. F. Varley, Esq.

Sir,—Your favour of the 1st inst. . . . . . .

Taking it for granted that the speed now attained by the working of the Morse instrument is adequate to the w required, of course my proposal would be of no advantag I think I shall be able to show that the greatest possib that can be got through one wire will be of the greatest adv for, as competition increases, companies will have either t new wires, or get more work through their present wires.

Now, supposing that in the case of a cable with one wi that that one wire has constant employment, and at th most can only get 720 messages off in 24 hours—that is, av it at 30 messages per hour—what is to be done should messages be handed in? increasing clerks would be of n but get the speed up to 1,440 messages, and additional cl write, will do easily that which under the old system is possibility; and another advantage would be that interm stations would have less time to wait; take a station havi messages to send occupying 20 minutes, and another req the circuit, increase the speed to double and the waiting will only have half the time to wait. Was the double marks you allude to worked with *one or two wires?* becau proposed plan is a double line of marks worked with one *all dots* and *no dashes*, hence the time gained. Taking a do unit, and a dash as three, and supposing (by way of illus that a unit of a letter occupies one second of time, to sen present alphabet would occupy 2 minutes 50 seconds, where proposed one would only occupy 1 minute 25 seconds, the f containing 170 units, and the latter only 85; and I think learner the symbols in double lines would be more easily acq while to those who have already learnt the Morse alpha would at once be familiar. The double line of dots are ob by two Morse levers worked by a relay.

Underneath is the alphabet—



All being dots, I anticipate there would be no confusion careless sending as to whether it is a dash or a dot.

. . . .

I think there would be more economy in increasing the of junior clerks as writers than having to erect additional which also means additional clerks. &c., &c., &c.

I am, Sir,
Your obedient servant,
(Signed) JNO. WM. FLET

[redacted]